AERONAUTICAL ENGINEERING REVIEW

NOVEMBER 1947

INSTITUTE OF THE AERONAUTICAL SCIENCES

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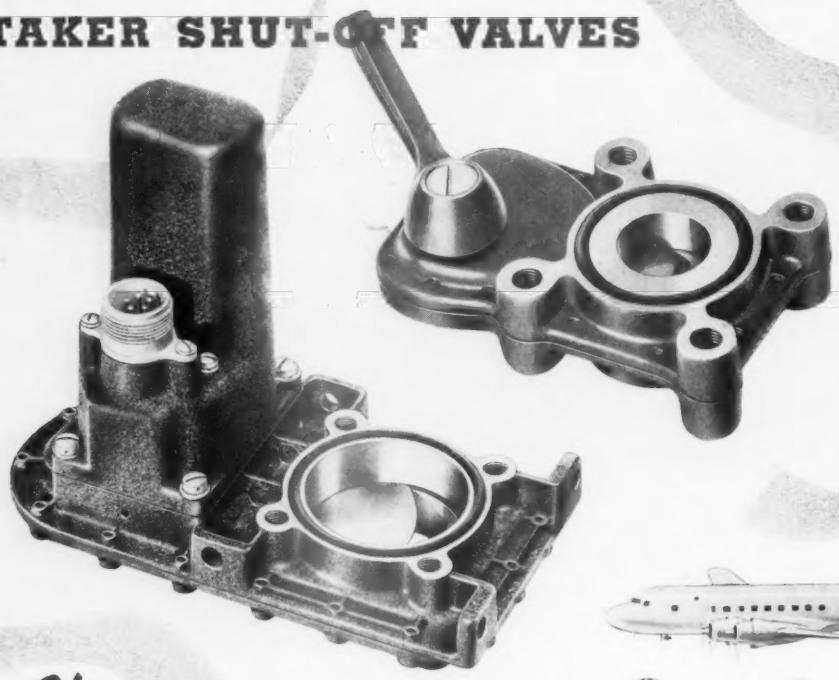
WHITTAKER SHUT-OFF VALVES



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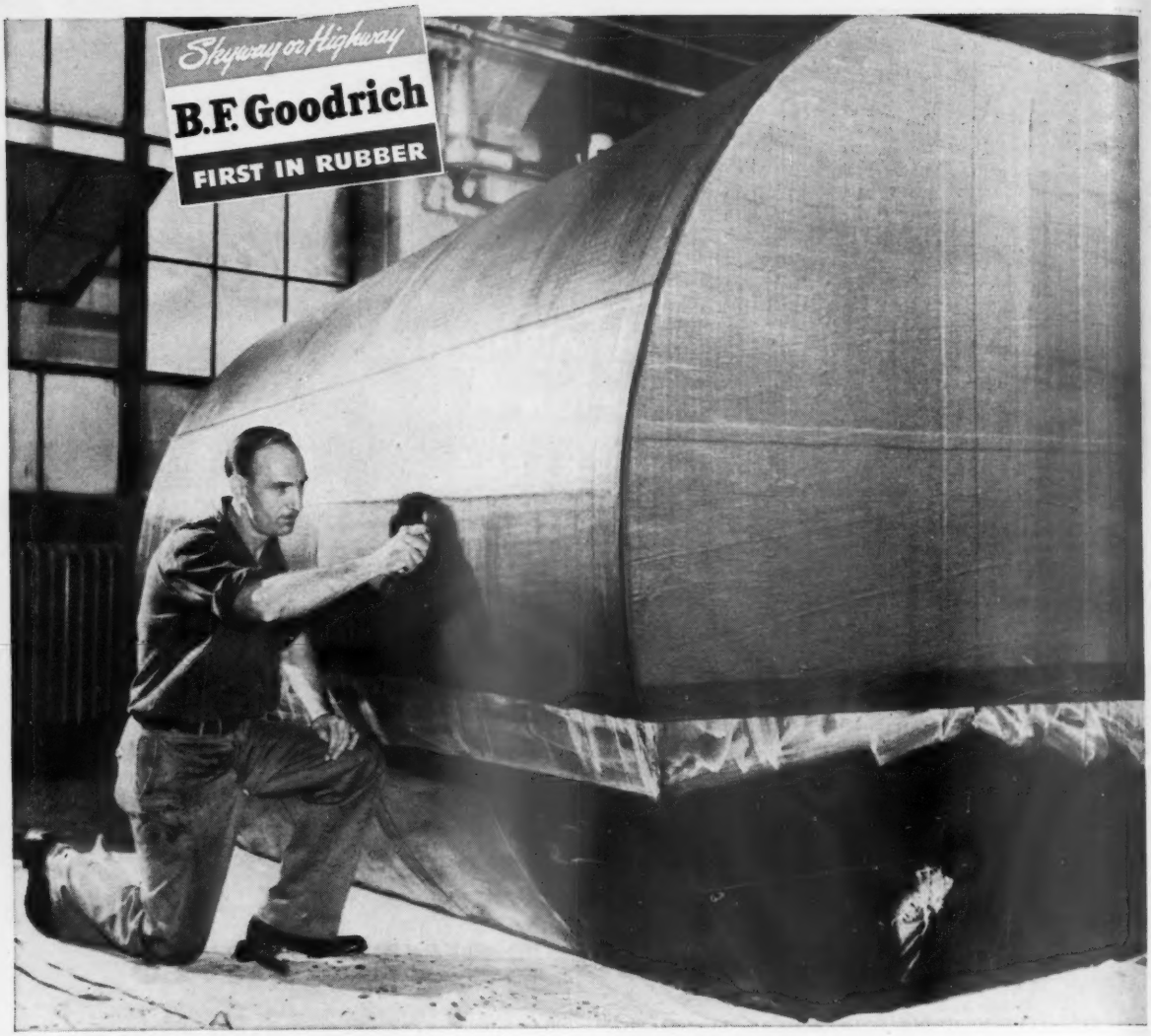

It takes a 2375-gallon drink upstairs without spilling a drop

SUPPLYING THE COLOSSAL THIRST of a new giant airplane called for a special system of fuel cells . . . one of them the largest ever built—2375 gallons!

The trick was to build a cell that big which would be leak-proof and self-sealing, would withstand shock and the strain of sloshing fuel, and would have minimum weight.

War-proved B. F. Goodrich fuel cell material, together with special bracing designed by B. F. Goodrich engineers, turned out to be the ideal answer. The 300 square foot cell was actually lighter than the plane manufacturer called for. And in AN tests a sample cell proved highly successful in withstanding the effects of pressure, load, negative pressure, sloshing, vibration and puncture.

The remarkable performance of this B. F. Goodrich self-sealing fuel cell results from its sandwich construction. An inner layer of rubber keeps the aromatic fumes, vital to the potency of aviation fuel, securely imprisoned. Two layers of sealant rubber swell on contact with the gasoline, prevent leakage in case of puncture. And rayon cord plies provide toughness and abrasion resistance.

This cell carries 2375 gallons of fuel aloft, through rapid altitude changes and fast maneuvers, without losing a drop. Other self-sealing fuel cells and bladder-type cells are produced by B. F. Goodrich to fit all types of planes. These fuel cells are a good example of how B. F. Goodrich keeps pace with the needs of the aviation industry. B. F. Goodrich is constantly working to make planes ever better, cheaper and safer. *The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.*

B.F.Goodrich

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Cover—Northrop XP-79 Flying Ram.

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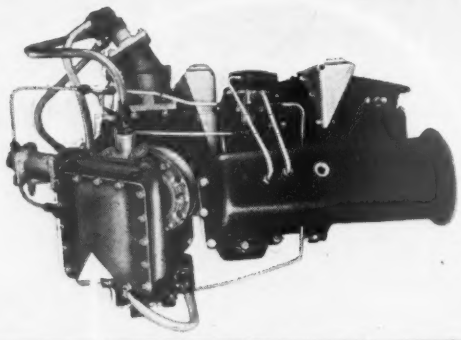

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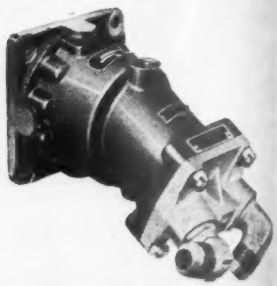
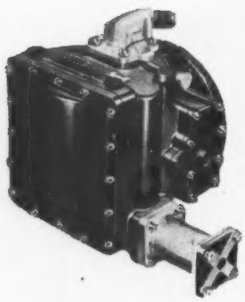


Vickers Hydraulic Motor



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Vickers Variable Delivery Pumps and Hydraulic Motor, used in combination as a variable speed transmission, were selected by Airesearch for accurate and dependable speed control of their cabin air conditioners. This Vickers combination permits operation of the supercharger impellor at any speed from 17,000 to 32,000 RPM at varying engine speeds. Output is controlled by cabin requirements to provide pressurization, and complete air conditioning for the extremely wide range of altitude and ambient temperature operating conditions encountered.

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I.A.S. News

A Record of People and Events of Interest to Institute Members

British Scientist To Present 11th Annual Wright Lecture

Professor Sydney Goldstein, Fellow of Royal Aeronautical Society and Chairman, Aeronautical Research Council, Great Britain, to Speak on Suction Airfoils, Chamber of Commerce Auditorium, Washington, D.C., December 17.

Professor Sydney Goldstein, 1947 Wright Brothers Lecturer.

COMMEMORATING the first airplane flight made by man on December 17, 1903, the Eleventh Annual Wright Brothers Lecture will be delivered on the anniversary of that date by Professor Sydney Goldstein, outstanding British scientist and aeronautical expert.

Under auspices of the Institute of the Aeronautical Sciences, the lecture will be given in the Auditorium of the United States Chamber of Commerce, Washington, D.C., scene of last year's lecture by the noted Dr. Th. von Kármán, Honorary Fellow of the Institute. The lecture will be open to all members and guests.

▸ **Airfoil Problems**—Professor Goldstein, Beyer Professor of Applied Mathematics, University of Manchester, England, a Fellow of both the Royal Aeronautical Society and the Royal Society of London, will speak on "Low-Drag and Suction Airfoils."

A lecturer in mathematics and aerodynamics since 1929—save for the period 1939–1945, when he worked in the Aerodynamics Department of the British National Physical Laboratory at Teddington, near London—Professor Goldstein has been Chairman of the Aeronautical Research Council since 1946. He is the author of numerous technical papers on aerodynamics and mathematics. Among his early papers, one of the most noted was "On the Vortex Theory of Screw Propellers," published in 1929.

▸ **Vortex Theory**—Many reports on the vortex theory, treating both the theoretic concepts and means for its practical use, have dealt with the applications not only to propellers but to rotary-wing problems, where the theory is applicable to hovering flight and vertical climb conditions.

Among other papers on aeronautics Professor Goldstein has authored are: "Concerning Some Solutions of the Boundary-Layer Equations in Hydrodynamics," 1930; "Boundary Layer Growth," 1936; "A Note on the Measurement of Total Head and Static Pressure in a Turbulent Stream," 1936; "Roughness and Turbulence," a report of the Aeronautical Research Council in 1937; "On the Velocity and Temperature Distributions in the Turbulent Wake Behind a Heated Body," 1938; and "The Linear Perturbation Theory of Compressible Flow, with Application to Wind Tunnel Interference," 1943. In addition, he is the author of numerous mathematical papers.

▸ **Mathematical Approach**—His approach to aerodynamic problems is primarily mathematical and, in his talk, Professor Goldstein will discuss the problems connected with mathematically designed airfoils. These will include both thick and thin wings.

The Wright Brothers Lecture, a feature event of the year in Institute activities, is endowed by The Vernon Lynch Fund, commemorating Wilbur and Orville Wright's flight at Kitty Hawk, N.C., in 1903. Professor Goldstein, who was born just 14 days before that historic flight, is the sixth foreign aeronautical scientist to be invited to deliver the lecture. This is in continuance of the Institute's policy to select, on alternate years (when possible), the Wright Brothers Lecturer from among the outstanding aeronautical scientists from Europe and the United States.

Prior to Dr. von Kármán's lecture, the lecturer was Dr. H. Roxbee Cox, noted British aviation engineer and new President of the Royal Aeronautical Society.

I.A.S. Calendar

December 17, 1947	Wright Brothers Lecture, Washington, D.C.
January 26–29, 1948	Sixteenth Annual Meeting, New York

For details see page 67

Twining Supreme Commander in Alaska Air Theater

Lt. Gen. Nathan F. Twining, veteran Air Force officer and Honorary Member of the Institute, has been assigned to command all American air, sea, and ground forces in Alaska, effective October 10.

▶ **Top Command**—General Twining thus becomes the first Air Force officer to assume supreme command in a major theater of operations under the new Department of National Defense. Both the Commanding General of the Alaskan Air Command, Major Gen. Joseph H. Atkinson, and Rear Adm. Alfred Montgomery, Commandant of Navy's Alaskan Sea Frontier, are subordinate to him. In addition, Alaska becomes an air theater.

General Twining's first task will be to coordinate all elements of the military services in Alaska in order to detect and intercept hostile aircraft operating across the polar region. Considered this country's most strategic frontier, Alaska is an exposed position. As Gen. Carl Spaatz, Chief of Staff, U.S.A.F., has warned, it will be in the path of the first blow directed against the United States in any future war.

Nordlinger Named Ranger Sales Director

S. G. Nordlinger has been appointed Director of Sales, Ranger Aircraft Engines Division, Fairchild Engine & Airplane Corporation, Farmingdale, N.Y., it was announced by George F. Chapline, General Manager of the Division.

Nordlinger, who had been Chief of Unconventional Power Plants Engineering in Ranger, is an Associate Fellow of the Institute.

▶ **Served in A.A.F.**—A Lieutenant Colonel in the Army Air Forces during the War, Nordlinger has had extensive engineering experience in aircraft-engine design, development, and manufacture. His military service included important technical assignments in development work in this country and in operations in overseas combat areas.

As Chief Engineer of the India-China division of the Air Transport Command, he was responsible for aeronautical engineering in connection with the "hump" operations and other air-transport activities in the India-China-Burma theater.

Previously, Nordlinger had served as Chief of Power Plants in the Production Engineering Section at Wright Field; A.A.F. Resident Representative at the Dodge-Chicago aircraft-engine plant; Technical Executive of the Mid-Central district of the Air Materiel Command, and Assistant to the Chief of Engineering and Maintenance at Air Transport Command Headquarters in Washington.

▶ **M.I.T. Graduate**—A graduate of Massachusetts Institute of Technology, Nordlinger served as an Army officer before taking charge of the Aviation Section of the Engineering Research Laboratories of Shell Oil Company. Later, he joined Continental Motors Corporation.

16th Annual Meeting Plans Stress Air-Carrier Problems

The Institute's Sixteenth Annual Meeting, to be held Monday through Thursday, January 26–29, 1948, at the Hotel Astor in New York, will lay special emphasis on air-transport problems, according to plans now being formulated. In addition, there will be joint sessions with other societies, the usual Honors Night Dinner, and prominent luncheon speakers.

▶ **Air-Transport Day**—Two innovations have been included in current plans for the meeting. One, an entire day will be devoted to problems relating to air transport. This arrangement is made to take the place of the Annual Air-Transport Meeting, usually held in October, in order to conserve time and expense of travel to a special assembly.

The other innovation is that there will be a Technical Session held on Monday, opening day of the meeting. This is made necessary as a result of including the full program on air-carrier problems.

In addition to the air-transport day, tentative plans call for technical sessions on aerodynamics, aircraft structures, design, propulsion, instruments, and meteorology.

▶ **Joint Sessions**—Included in the plans are joint sessions with the American Physical Society, on the subject of aerodynamics of the upper atmosphere; with the American Meteorological Society; with the Institute of Navigation; and with the American Helicopter Society.

Members planning to attend the meeting should make hotel reservations as early as possible—all facilities will be in great demand at that time of the year.

I.A.S. Newslines

▶ **Herbert Lee Bowers,** Associate Fellow, has been named Aeronautical Engineer, Aircraft Engine Research Laboratory, National Advisory Committee for Aeronautics. He had been with Bell as Chief Development Engineer.

▶ **W. A. M. Burden,** who joined Smith, Barney & Co., Wall Street investment house as specialist in aviation field October 1, strongly advocated a separate Department of Civil Aviation in an appearance before President's Air Policy Commission. Burden, an Honorary Member and former Assistant Secretary of Commerce for Air, would like aviation to have a Cabinet post.

▶ **Charles H. Colvin,** a member of President Truman's Air Policy Commission and a Fellow of the Institute, experienced some upside-down flying during an air mishap last month. The transport in which he was riding to Los Angeles from Dallas turned over on its back as it passed over El Paso, Tex., October 8, completing half of an outside loop. Although the 48 passengers were considerably shaken up, the plane was landed safely at El Paso Municipal Airport.

▶ **James H. Doolittle,** former President of Air Force Association, was named Chairman of A.F.A. Board. Doolittle, a Fellow of the Institute, is Vice-President of Shell Union Oil Company.

▶ **Lt. Gen. Ira C. Eaker,** retired Deputy Commanding General of A.A.F., was named a Vice-President of Hughes Tool Company; will be assistant to Noah Dietrich. Eaker, an Honorary Member, who laid foundations of the Eighth Air Force bombing offensive in England early in 1942, is taking his first civilian position.

▶ **William R. Enyart,** Vice-President of Fédération Aéronautique Internationale, was among the U.S. delegation at the Geneva convention in September. Enyart, President of Simmonds Aerocessories, Inc., is an Associate Fellow of I.A.S.

▶ **Joseph M. Gwinn, Jr.,** an Associate Fellow, is President of Gwinn Aircar Co.

▶ **Newman A. Hall** is Professor, Department of Mechanical Engineering, University of Minnesota. An Associate Fellow, Dr. Hall had been Head, Analysis Section, United Aircraft Corp.

▶ **Harold V. Hawkins,** Associate Fellow, resigned from Bell Aircraft to become Professor of Civil Engineering, Illinois Institute of Technology.

▶ **R. M. Hazen,** Fellow and Member of I.A.S. Advisory Committee, told Air Policy Commission that all new large aircraft purchased 5 years from

now may be powered by turbine engines. He is Director of Engineering, Allison Division of General Motors.

▸ **Joel Martin Jacobson** resigned as Assistant Chief Engineer, Fairchild Aircraft Division, to return to The Glenn L. Martin Company where he is Director, Technical Engineering Department. He is an Associate Fellow.

▸ **J. H. Kindelberger,** President, North American Aviation, Inc., and I.A.S. Fellow, urged stockpiling now of critical materials as only way a peacetime industry could spring quickly to wartime production. Materials coming out of the mine today, he said, cannot be flying tomorrow.

▸ **Boris Korvin-Kroukovsky,** Research Professor at Stevens Institute's Experimental Towing Tank, is directing research on planing action of floats and flying boat hull bottoms now being conducted under contract with Navy's Office of Naval Research. Work will continue until spring of 1948. Professor Korvin-Kroukovsky is a Fellow of the Institute.

▸ **Curtis E. LeMay,** Honorary Member, has been promoted to rank of Lieutenant General. LeMay, formerly Deputy Chief of Staff for Research and Development, was appointed Commanding General of U.S. Air Forces in Europe.

▸ **Eugene P. Resos,** formerly Engineering Supervisor, Fuselage Project, North American Aviation, Inc., has been transferred to the Missile Structures Design and Development Department of the Aerophysics Laboratory. Resos is an Associate Fellow.

▸ **Paul E. Richter,** Associate Fellow and former Executive Vice-President of T.W.A., was elected President and Chairman of the Board of TACA Airways, S.A., September 15.

▸ **T. Claude Ryan,** President of The Ryan Aeronautical Company and Member of Institute's Advisory Committee, believes that, barring a national economic depression, there should be little trouble holding the present market for personal planes and expanding it gradually.

▸ **Igor I. Sikorsky,** Engineering Manager of Sikorsky Aircraft Division of United Aircraft and Honorary Fellow of the Institute, received the Gold Medal of the Fédération Aéronautique Internationale at opening session of F.A.I.'s 40th general conference in Geneva, September 17.

▸ **Gen. Carl A. Spaatz,** Commanding General of U.S.A.F. and Honorary Member of the Institute, was named Chief of Staff for Air.

▸ **Dr. Th. von Kármán,** Honorary Fellow of the Institute, has been named Visiting Professor in the Physics Department, Columbia University.

Re-Elected President of Early Birds: *George H. Scragg, recently re-elected President of the Early Birds, aviation pioneers, standing before his new Cessna bearing Early Bird insigne.*

Early Birds Re-Elect I.A.S. Members

George H. Scragg and Brig. Gen. Frank P. Lahm (Ret.) were re-elected to the offices of President and First Vice-President, respectively, of the Early Birds, aviation pioneers, at the annual meeting held during the National Air Races in Cleveland. Both are members of the Institute.

President Scragg's experience in aviation goes back to the beginning of the industry, and he continues an active pilot today. In addition to being a pilot, his experience includes designing and building planes.

During World War I, Scragg served overseas, becoming Chief Technical Officer of the Night Bombardment Section, A.E.F. In World War II, he saw service as Commander of the Cleveland Group of Civil Air Patrol and later as Public Relations Officer of C.A.P., Ohio Wing, as a major.

▸ **Soloed in 1909**—General Lahm, who has held licenses for balloons and airships since 1905, soloed in a plane October 18, 1909, one of the first Army officers to pilot an aircraft. His instructor was Wilbur Wright.

Retired Nov. 30, 1941, having reached the age of 64, General Lahm was at that time Commander of Randolph Field, so-called West Point of the air. He had organized the Air Corps Training Center at Duncan Field, out of which grew Brooks, Kelly, and finally, Randolph fields. During the first World War he won the Distinguished Service Medal.

Corporate Member News

● **Aerojet Engineering Corporation** has purchased the Azusa, Calif., plant from War Assets for $585,000.

● **Airborne Instruments Laboratory, Inc.,** has leased additional space for use of its executive offices for minimum of 2 years. Space in main laboratory building in Mineola, formerly occupied by executive offices, will be utilized by the expanded scientific, engineering, and technical groups. Total staff of 243 includes about 90 classed as scientists and engineers.

● **American Airlines System** has consolidated its former passenger and cargo sales divisions into one sales division.

● **Boeing Aircraft Company** has moved its Washington headquarters from 507 American Security Building to 403 Commonwealth Building, 1625 K Street, N.W. . . . Company is developing new heavy bomber, the XB-52, now in preliminary stages.

● **Consolidated Vultee Aircraft Corporation's** San Diego Division won the National Safety Council's distinguished service to safety award for injury-free, 97-day period totaling 3,472,718 man-hours.

● **Eastern Air Lines, Inc.,** held a 2-day staff meeting of company's Junior Management Group, October 13–14, at Miami, attended by supervisory personnel.

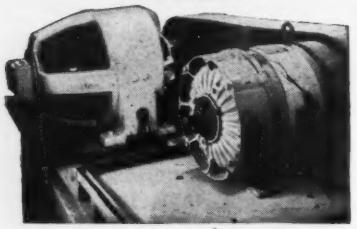
● **Engineering & Research Corporation** has signed an agreement with Sanders Aviation, Inc., Riverdale, Md., under which Sanders will take over all spare parts and service functions for the Ercoupe. Agreement further provides for continued manufacture of spare parts and airplanes by Erco for the account of Sanders and covers sale of planes produced by Erco in 1948 and thereafter.

Silicone News

DC SILICONES

Lubricated once with DC 44 Grease...

Bearings Run 3820 Hours at 250° F.



DC 44 Silicone Grease is tested in bearings of DC Silicone insulated motors overloaded to bring bearing temperatures up to 125° C.

DC Silicone Greases, like other Dow Corning Silicone Products, permit operation at temperatures far above and below the limits of comparable organic materials. The Silicone Greases were, in fact, developed to solve a high temperature problem of our own making.

We had developed and were testing DC Silicone Insulation for electric motors. We operated test motors at 200° to 310° C. and found that Silicone Insulation could take such temperatures for thousands of hours. We knew, however, that there would be almost no immediate market for this new class of electrical insulation unless a grease having comparable heat stability was developed.

Then one of our research groups developed DC 44 and DC 33. That was over two years ago. DC Silicone Greases have since been extensively tested and widely used.

DC 44 has proved to be serviceable from −40° to 350° F. and at speeds up to 20,000 r.p.m. It is also characterized by very low volatility, freedom from gumming, bleeding of less than 2% after 16 hours at 110° C. (230° F.), and weight loss of only 3.3% after 40 hours at 175° C. (347° F.).

These properties are most desirable in a grease for permanently sealed bearings. DC 44 is now used for that purpose.

DC 33 has proved to be a very useful grease over the temperature span covered in aircraft operations. It is serviceable at temperatures as low as −70° F. and still has better high temperature performance than special high temperature petroleum greases. Both of these DC Silicone Greases are described in data sheet No. S 7-4.

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● **Fairchild Engine and Airplane Corporation** reported a net profit for 1946 after taxes of $962,048, equivalent to 42 cents a share on the 2,302,707 common shares outstanding.

● **Lear, Inc.**, has named Flight, Inc., Cleveland, and Gulf Aeronautics, Dallas, as Class A distributors. This brings to 60 the number of Class A franchised distributors for Lear aviation radio products in U.S.

● **Minneapolis-Honeywell Regulator Company** has announced organization of new subsidiary in Switzerland, Honeywell, A.G. New company handles sales and service of complete line of Honeywell controls, as well as all industrial and controlling devices made by Brown Instrument Co., another Honeywell subsidiary.

● **Northwest Airlines, Inc.**, reports a profit after taxes of $565,793 in August compared with $225,796 in August, 1946.

● **Pesco Products Company Division,** Borg-Warner Corporation, has started construction of $120,000 laboratory on a new 35-acre site in Bedford Township near Cleveland. Lab will be used for testing aircraft fuel systems.

● **Republic Aviation Corporation** has discontinued Seabee production for personal plane market but will continue to provide spare parts and service for planes already sold. Move, according to company, was due to "need of all of Republic's production facilities for the manufacture of other types of airplanes. . ."

● **A. V. Roe Canada Ltd.** is designing and building jet engines; will soon test Canada's first aircraft jet engine, the "Chinook." "Chinook" is name given Avro T.R. 4 MK II axial-flow turbojet, an experimental model of 3,000-lb. static thrust for take-off. Prototype will be test-flown but not produced. Larger model, producing 6,700-lb. thrust, to be built later, will power Avro C-102 air liner.

● **The Ryan Aeronautical Company** has sold the design rights and production tooling for its nonaeronautical products in order to make facilities available to its expanding personal plane production program.

● **Shell Oil Company** laboratories have developed a method of determining jet-aircraft-engine efficiency. Sample of exhaust gas is captured as it leaves engine and subjected to quantitative analysis, after previous measurement of exact composition of fuel entering engine. Tests indicate "carboning up" can be reduced by altering various fuel factors.

● **Simmonds Aerocessories, Inc.**, announced the opening of new permanent facilities at 105 White Plains Road, Tarrytown, N.Y., September 1. All Simmonds offices in Long Island City have been closed.

● **Solar Aircraft Company** is developing an afterburner for use with turbojet engines.

● **Sperry Gyroscope Company, Inc.**, has formed new department to take on subcontracting work, company announced, saying it has more than 1,000,000 man-hours available annually.

● **United Air Lines, Inc.**, flew more than a million air-freight ton-miles in a single month for first time in company's history. By operating 1,024,874 ton-miles in September, United topped by 36 per cent its August figure of 752,641 ton-miles and by 130 per cent the number flown in September, 1946. . . Company is planning new station and hangar facilities at Seattle-Tacoma Airport near Seattle. New facilities will accommodate upwards of 500 operation and passenger service employees.

Gifts to the Institute Collections

The Mayo Aero Medical Unit presented six volumes of *Studies in Aviation Medicine* made during the war years, through the courtesy of Dr. Walter M. Boothby. The Air Materiel Command added more than 400 *A.A.F. Technical Reports* published in 1945, 1946, and 1947 to its previous generous gifts. The U.S. Forest Products Laboratory gave 45 technical reports. Its six-volume *Airline Traffic Survey* of September, 1946, was received from the Analyses Division of the Civil Aeronautics Board. Jerome Lederer sent C.A.A. *Technical Development Notes* and *Technical Development Reports*. The Eclipse-Pioneer Division of Bendix Aviation Corporation, through the courtesy of Miss Mildred M. Baker, gave 700 N.A.C.A. *Wartime Reports*. The Aeronautical Digest Publishing Company, through the courtesy of Nathaniel F. Silsbee, sent N.A.C.A. *Technical Memorandums*, *Technical Notes*, and *Wartime Reports*. The *Journal of the Royal Aeronautical Society* for 1945 and 1946 was received from K. H. Wilde. Three translations from German technical reports were received from the Cornell Aeronautical Laboratory through the courtesy of Miss Elma T. Evans.

Insignia of the air forces of six countries, including a pilot badge of 1925 of the Rumanian Air Service, were added to his previous generous gifts by Robert Blackburn, of London. Zeppelin and other flight covers, and the original drawings used to illustrate his book, *Man's Fight to Fly*, were among the additions made to his previous generous gifts by J. P. V. Heinmuller. Mrs. Bella C. Landauer and William Landauer added to their previous gifts with a program and badge of the first anniversary dinner of the Air Forces Association. A section of the wing spar of the flying boat Caledonia, which flew more than 2,000,000 miles between 1936 and 1946, was received from British Overseas Airways through the courtesy of G. A. W. Wynne.

Additional gifts were received from the Aluminum Research Institute; Australian Council for Scientific and Industrial Research; Boeing Aircraft Company; Esso, Inc.; Dominion of New Zealand; National Fire Protection Association; Civil Aeronautics Administration; Civil Aeronautics Board; National Advisory Committee for Aeronautics; National Bureau of Standards; Office of Domestic Commerce; President's Scientific Research Board; Rocket Propellant Information Agency of The Johns Hopkins University; Smithsonian Institution; Society of Automotive Engineers; University of Alabama; and the Wings Club.

Sections and Branches

Buffalo Section

A. Flax, *Secretary*

With an attendance of 60, Section members met September 25 to hear W. C. Lawrence, Chief Engineer, American Overseas Airlines, Inc., on "Airline Engineering in International Operations."

At the same meeting, new officers were announced as follows: Chairman, Allen F. Donovan; Vice-Chairman, John F. Strickler, Jr.; Secretary, A. Flax; Treasurer, Fred T. Sarginson; Advisory Committee, Frederic Flader and William M. Duke; Nominating Committee for Area Councilor, Robert M. Stanley.

In addition, selection of the "best paper of the year" was announced, the award going to Edmund V. Laitone.

▸ **Long-Range Operations**—Lawrence, in his paper, discussed the problems of long-range air-line operations and compared them to short-range domestic runs.

Explaining the position of engineering air-line operation, he listed activities air-line engineering service generally engages in. These included aircraft procurement; development of specifications and requirements; technical supervision and coordination of maintenance, operation and engineering; establishment of airworthiness standards; modification of aircraft and equipment; liaison in technical problems with C.A.A., C.A.B., manufacturers, etc.; study of the application of equipment for new routes; initiation of test flights; preparation of technical operation manuals; and supervision of personnel training.

In the operation of American Overseas Airlines, Lawrence noted the political factors involved, such as conflicting immigration laws, landing rights, etc.; the financial factors, such as exchange rates, control of foreign money, control of imports, treatment of traffic, landing rates, fuel costs, labor rates; and general problems, such as weather conditions and vacation travel in the summer.

Bases of operation are well established, Lawrence said, although some routes are still somewhat in the "barnstorming" stage. He cited some good work accomplished by Air Transport Command and Pan American World Airways in establishing bases in the Pacific, where the same type of problems were encountered.

▸ **Compares Operating Ranges**—In the operation of overseas lines, the operating range compares with the domestic range about tenfold, Lawrence said. That is, the domestic passenger rate is generally between 200 and 500 miles, while the overseas rate is between 2,000 and 5,000 miles. This imposes a more difficult problem on overseas lines in maintenance, requires added skill from the crews, necessitates larger crews, and imposes greater difficulties in communications.

Last, but not least, a meteorological service is required.

▸ **Passenger Problem**—From the passenger standpoint, because of the long flight, there are problems of reservations, temperature control, complete food service. In addition, storage facilities must be increased to accommodate the extra baggage taken on long trips.

To deal with these problems, the Engineering Department is organized in two divisions: the Flight Division—composed of the technical training branch for crews; operational branch to determine bases, ranges, cruising speeds; and analysis branch coordinating with C.A.A., C.A.B., and manufacturers—and the Aircraft Division—also organized into branches that take care of any type of equipment.

Calendar

I.A.S. Section Meeting

DETROIT—DEC. 8

Engineering Society of Detroit

Speaker: Thomas Doe

"New Applications for Hydraulics"

Hagerstown Section

G. L. Hackenberger, *Secretary*

Discussion of the new "channel wing" aircraft by its designer, Willard R. Custer, of the National Aircraft Corporation, Hagerstown, featured a meeting of the Section early last summer in the Washington County Museum of Fine Arts. A second notable paper was given by Willy Ley on "Rocket Fuels" in the September 10 meeting.

The channel wing design is the result of 20 years' work by Custer which, while decidedly unconventional, has proved in both flight and wind-tunnel tests for the Air Force that claims made for its performance are conservative.

▸ **A Safety Device**—Custer stated that his design is to be presented to the industry not as a panacea for all personal aircraft ills nor as a step forward which will revolutionize the whole industry but merely as a safety device to augment conventional types of high lift devices.

Results of tests, however, would seem to prove amply that Custer is conservative in this announced aim and that further applications would seem practically inevitable if subsequent flight testing bears out the promises of earlier tests.

By use of his device, Custer declared, flight in the conventional manner at conventional speeds is possible, but in the event of an emergency, such as fog or overcast, a pilot could make a safe and completely controlled landing with a forward velocity of no more than 15 m.p.h. These claims he substantiated by quoting from *A.A.F. Technical Report 5568* on flight and wind-tunnel tests of his design.

▸ **30 Per Cent More Lift**—It was stated that the channel wing aircraft, which had a gross weight of 1,785 lbs., was flown at an airspeed of 65 m.p.h. with a total developed horsepower of less than 27 and that safe landings were possible in the event of engine failure, inasmuch as the channels produced 30 per cent more lift than that developed by the conventional wing. This was due, Custer said, to the endplate effect of the channels in minimizing tip losses.

The aircraft was said to be inherently stable under all conditions and capable of air speeds comparable to those of conventional aircraft of the same power and weight.

▸ **Explains Method**—Custer explained his method of achieving these surprising results as follows: With any conventional wing, most of the lift

(*Continued on page 61*)

Dr. Vannevar Bush, former N.A.C.A. Chairman and wartime Director of O.S.R.D., has been appointed by President Truman to be Chairman, Research and Development Board, National Military Establishment.

Editorial

On September 25, the President of the United States addressed a letter to Dr. Vannevar Bush in which he said in part:

> "I am happy to know that you are willing to continue in the public service as Chairman of the Research and Development Board created by the National Security Act of 1947. . . . . The coordination of our scientific effort is one of the most important objectives of the. . . . Act. It is a fortunate circumstance that, in carrying out these objectives, the Research and Development Board will have the benefit of your guidance."

This is the sentiment that all of us in the Institute of the Aeronautical Sciences heartily endorse. Van Bush is not only a longtime personal friend and mentor to many of us, but he is widely (and well) known to the entire aeronautical industry as a former Chairman of the National Advisory Committee for Aeronautics. His tour of duty with the N.A.C.A. is of particular interest in the light of his new responsibilities. We know that he can lend a sympathetic and understanding ear to the many and complicated problems that face the aeronautical engineering profession in the immediate future.

But the appointment has far broader implications, aeronautically speaking, than the establishment of "a friend at court." Few men of our time possess the breadth and depth of background in as many fields of science as does Dr. Bush. His basic training was in electrical engineering and mathematics. His subsequent activities established him firmly in the top ranks of scientific research, education, and invention. Also, in the realms of biology, chemistry, and nuclear physics, he is no stranger.

In whatever field of endeavor, his major interest has always been in the development of apparatus to free man's intelligence for creative effort.

Aeronautical development will benefit greatly from the appointment of Dr. Bush to the country's key research position. At this time the classic concepts of aeronautics are being rapidly outmoded, and we are reaching into every other field of science for the means to solve such problems as supersonic and interstellar flight. The continuing advice and guidance of a man of the caliber and attainments of Vannevar Bush will be invaluable.

Through the overall coordination with all scientific endeavor which his organization can provide, aeronautical people will not only be given access to vast new storehouses of information but will also be steered away from unnecessary duplication of effort and from pitfalls into which others have already fallen. If ever some top-side coordination was necessary, the time is now.

For many years the Institute has been laboring in the same vineyard. With the means at our disposal, we have been working to keep the aeronautical engineering profession abreast of the latest information in the field, to eliminate duplication of effort, and to encourage standardization of procedures. Against that background of experience we can gauge the difficulties of the larger problems that face Dr. Bush, but we can also appreciate the beneficial effects to our national security which will stem from his endeavors.

As individuals, and as an organization, we pledge to him our fullest cooperation. We wish him well in the tremendous task he has undertaken.

S. P. J.

Trends in Aircraft Power Plants*

MILTON U. CLAUSER†
Douglas Aircraft Company, Inc.

Introduction

An aircraft manufacturer who is interested in long-range planning must be able to predict the performance of the engines that he expects to use in his aircraft. If his estimates are too optimistic, he will be disappointed when he receives his engines behind schedule or deficient in performance. If he is too pessimistic, he may find it difficult to obtain new business. The engine manufacturersdo not publish any long-range estimates, probably because of the increasing number of types of engines.

In making comparisons between the different types of power plants, it immediately becomes apparent that the time variable is as important here as it has become in modern physics. It must be recognized that, when analyzing the design of a new airplane, the performance of a proposed propeller turbine cannot be compared directly with that of a reciprocating engine that has passed its model test. Each must first be adjusted to the same scale of development.

Predictions Based on Past Progress

One of the most reliable methods of predicting progress is to study our history in order to ascertain any trends; these trends may then be extended into the future. This is the method often used by modern economists, sociologists, and biologists. When applied to the progress of the aircraft industry, the results have proved helpful.

Progress of Maximum Brake Horsepower Output

The aircraft manufacturer gages engine progress by the maximum horsepower that he can obtain. In Fig. 1 are plotted the brake horsepower outputs of the engines that have been used in the fastest military aircraft throughout the world. Larger engines may have been in existence but were not used in the airplanes referred to in references 1, 2, and 3 and other sources.

These data show the rapid progress that has been made since the Wright Brothers' first powered flight with a 12-hp. engine. The effect of the two World Wars is also apparent; in both cases the slope of the curve is about doubled. On a semilogarithmic or ratio scale plot this means that the percentage rate of increase is doubled.

Although the largest part of our history appears to be influenced by these two wars, there does seem to be a basic trend line to which we returned after World War I and to which we may return after World War II. This may be discerned in other performance trends. It is in accord with the findings of some modern economists who have discovered[4] that trends and cyclic phenomena that are markedly influenced by war emerge shortly after the war undistorted in both phase and amplitude.

The basic trend line has a continuously decreasing slope that is often common to other growth phenomena. Although our absolute progress is still accelerating rapidly, our percentage increase is beginning to decline and indicates that we may be approaching an asymptote.

Also plotted on Fig. 1 are the equivalent brake horsepowers for several jet engines. These have been obtained by using the thrust of the engine and the maximum speed of the airplane in which it was installed. A fictitious propeller efficiency of 85 per cent was used. It should be noted for the moment that the jet powers are above those of the reciprocating engines.

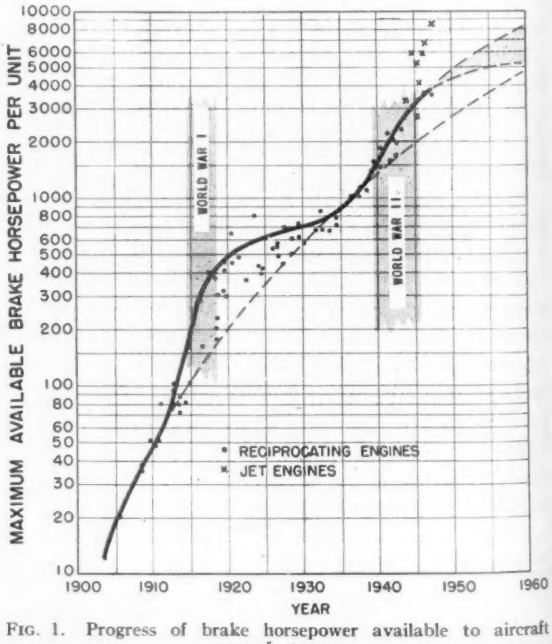

Fig. 1. Progress of brake horsepower available to aircraft manufacturers.

Presented at the Annual Summer Meeting, I.A.S., Los Angeles, August 7–8, 1947.

* A large portion of the credit for the preparation of this paper goes to Miss Patricia Franck, for it was she who did the work of assembling and analyzing most of the material. The author also wishes to thank E. H. Heinemann, T. D. MacGregor, L. E. Root, and W. Moore for their help and suggestions.

† Chief, Mechanical Design Section.

Effect of Increasing Horsepower on Airplane Performance

In Fig. 2 the maximum speeds of fighter aircraft with these engines have been plotted. Fighter aircraft have been considered simply because they make the best use of their power to get high speed. Some turbojet-engine airplanes have been included.

It is interesting to compare the characteristics of this curve with those of Fig. 1. Our rapid progress since the Wright Brothers' first powered airplane is again apparent. The effect of World War I is also marked, but, surprisingly enough, World War II seems to have resulted in little change. A basic trend curve is discernible but, in this case, it seems to be a straight line rather than a curved one, except in recent years when the reciprocating-engine airplanes have not been able to maintain their progress. The jet-engine airplanes have stepped in and kept the curve moving up. It is surprising, in view of Fig. 1, that the jet-engine airplanes are not further above the reciprocating-engine airplane line than this curve shows them to be.

From this comparison the following questions will require closer study:

(1) Why did not World War II result in a marked acceleration in speeds when the horsepowers did show such an improvement? (2) Why is the trend line for speeds apparently straight, while it is curved for the horsepower development? (3) Why do not the jet-engine airplane speeds show more of an improvement over the reciprocating-engine airplane speeds?

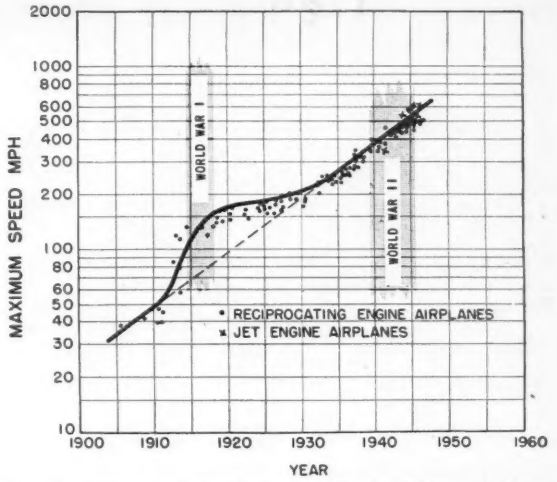

Fig. 2. Progress of maximum speed of military airplanes.

Effect of Compressibility

Aerodynamicists will recall that they began to encounter compressibility troubles at the beginning of the war. This may have something to do with the answer to the first question Some of the speeds, including those of the jet-engine airplanes, have been corrected to eliminate the effect of compressibility on the drag rise; these corrected speeds are plotted in Fig. 3. The effect of World War II now becomes more noticeable, and this then, is the answer to question (1). On the other hand, the differences between the jet- and reciprocating-engine airplanes have been minimized, therefore questions (2) and (3) still need to be answered.

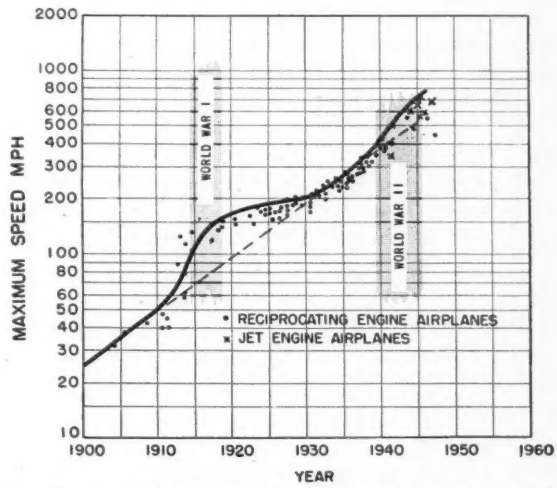

Fig. 3. Speed of military airplanes corrected to eliminate effect of compressibility.

Progress of Engine Supercharging

The maximum brake horsepower of a reciprocating engine usually occurs at sea level, whereas the maximum speed of a reciprocating-engine airplane usually occurs at the highest critical altitude. At the same time, a jet-engine airplane usually has its high speed at or near sea level. Since these differences bear on the above questions, a study of the progress of engine supercharging is warranted.

From the approximate performance equation:

$$\text{b. hp.}(\eta_{\text{prop.}}) = (1/2)\rho V^3 f$$

or

$$\text{b. hp.}/\sigma = V^3[(1/2)\rho_0 f/\eta_{\text{prop.}}]$$

This means that if the parasite drag area f and the propeller efficiency $\eta_{\text{prop.}}$ are approximately constant, the cube of the speed varies as the brake horsepower and inversely as the relative air density σ. Thus, increasing the altitude at which a given power can be obtained is as important as increasing the power.

In Fig. 4 has been plotted the reciprocal of the relative air density corresponding to the highest critical altitudes of the engines shown on Fig. 1. These data show that supercharging of engines began about 1928 and has improved steadily ever since. The magnitude of this improvement is such that it would certainly influence the performance of airplanes.

Progress of Equivalent Sea-Level Brake Horsepower

It is not possible to obtain a correct picture of the overall improvement that engines have contributed to

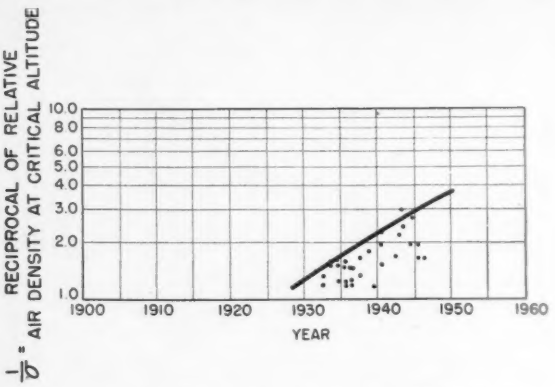

FIG. 4. Progress of aircraft-engine supercharging.

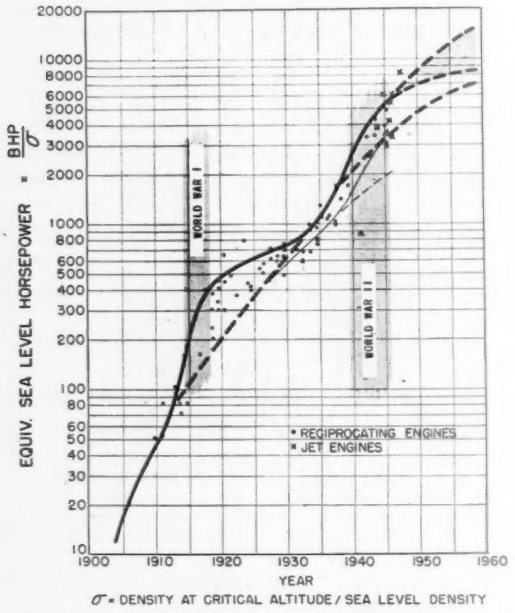

FIG. 5. Progress of equivalent sea-level brake horsepower.

airplane performance by multiplying the curve of Fig. 1 by that of Fig. 4 because: (1) Few engines are able to develop their maximum horsepower at their highest critical altitude; (2) the highest powered engines do not always have the maximum supercharging. For this reason, an "equivalent sea-level brake horsepower," which is defined as the brake horsepower at the engine's critical altitude divided by the relative density of this altitude b.hp./σ, is plotted in Fig. 5. This equivalent sea-level horsepower (eq. s.l. hp.) should be considered as the horsepower an airplane would have to have at sea level in order to attain the same true speed there that it has at altitude.

The basic trend line shown for this figure is really two curved lines. The first one, of course, is the same as the lower part of the basic trend line for Fig. 1. The second curve is somewhat arbitrarily drawn, since there are few data other than the curvature of Fig. 1 to go by. In fact, a straight line in place of these two curves would give a reasonably good fit.

The answers to our second and third questions are now apparent. Although the engine manufacturers have not kept up their same percentage progress in brake horsepower development, they have been able to maintain their overall contribution to the airplanes performance by supercharging their engines to higher altitudes. Thus, the basic trend lines of both airplane and engine performance are approximately straight lines.

From Fig. 5 it can be seen that the equivalent sea-level horsepowers of reciprocating engines are almost as high as those of jet engines, which explains why the corrected speeds of the two types are not far apart. If they are given their full credit, it is clear that the reciprocating-engine manufacturers have done well so far, but it is also clear that jet-engine progress is just beginning and soon may be expected to make a better showing.

Expected Progress of Turbojet Engines

Of all of the new type engines—namely, turbojets, propeller turbines, rockets, ram-jets and pulse-jets—only turbojet engines have enough points to show the start of a trend, and even here the data are still sketchy. Fig. 6 shows the static sea-level thrusts of a number of jet engines. The progress that the performance of these engines has made is truly remarkable. This progress, however, can be expected to slow down some for the following reasons:

(1) The initial progress was war-inspired and experience indicates that this rate will not be sustained. (2) More emphasis will be placed on improving the reliability of the components and accessories and on increasing the overhaul periods. (3) More care will be given to anti-icing, mounting, fire prevention, and other installational requirements.

With these points in mind and our past experience in reciprocating engines as background, a guess is hazarded as to what the future maximum power output will be. This is the solid line on Fig. 6. The broken line is an extension of the present trend.

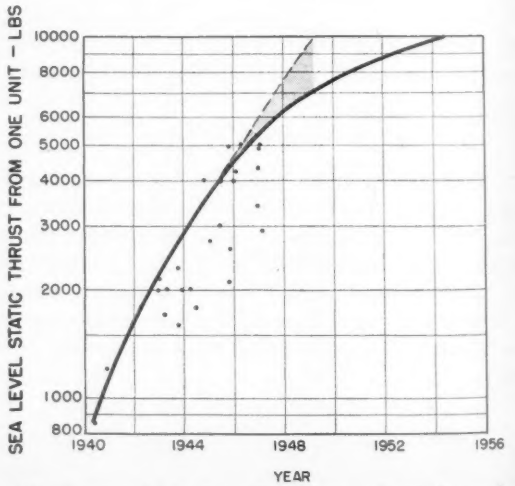

FIG. 6. Progress in static sea-level thrust of turbojet engines.

Progress in Engine Efficiency Factors

It is of interest to see what progress has been made in improving the efficiency of aircraft engines, since this may require more ingenuity than increasing the maximum output. Two factors are of immediate importance to the aircraft designer. The first is the specific weight of the engine or its reciprocal, and the second is the specific fuel consumption.

Trend of Equivalent Horsepower per Pound of Engine Weight

In Fig. 7 is plotted the ratio of the equivalent sea-level horsepower to the dry weight. The equivalent sea-level horsepower is used in order to give the engine manufacturers credit for the weight they put into supercharging. These data are of interest, for they show less effect of the war years than any of the previous data. This trend might be expected, since in time of emergency, the engine manufacturers probably increased their horsepower output by any known means and paid less than the usual attention to efficiency.

The basic trend of Fig. 7 is clear and allows an attempt to use analytical growth curves developed in other fields. In reference 5, Professor Pearl presents a method of fitting an analytical curve to various growth phenomena. His curves show remarkably good correlations with the observed data. This same method and others similar to it have been used in studying economic trends and social developments.[4]

Professor Pearl uses a curve of the form:

$$y = k/(1 + e^{a_0 - a_1 t})$$

where y is the quantity to be measured, t is the time (e.g.—in years), and a_0, a_1, and k are constants to be determined by the data. If this equation is differentiated, it can be put in the form:

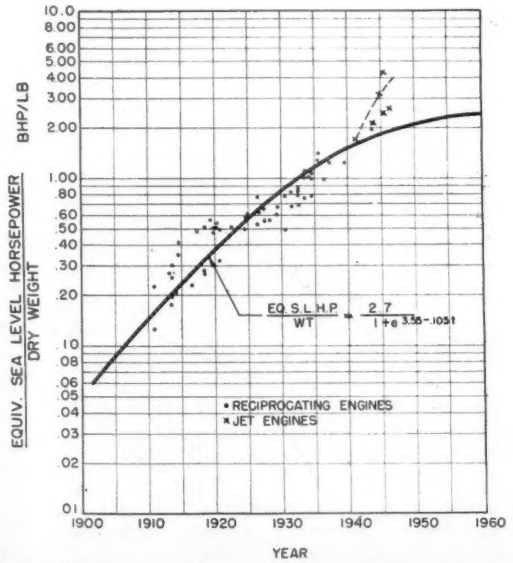

Fig. 7. Progress in ratio of equivalent sea-level brake horsepower to engine dry weight.

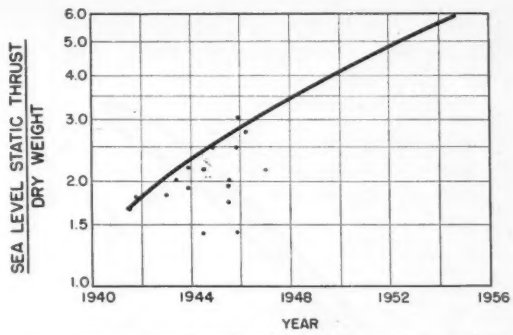

Fig. 8. Improvement in ratio of static thrust to dry weight for jet engines.

$$dy/dt = (a_1/k)(k - y)y$$

This means that, initially, when y is small (compared to k), the per cent growth is constant: $dy/dt = a_1$; or, when integrated, $\log y = a_1 t - a_0$. This is a straight line on semilogarithmic coordinates. As y approaches k the per cent growth decreases. Thus, the curve approaches k as an asymptote. A curve of this form has been fitted to the data of Fig. 7. The equation is

$$\text{eq. s.l. hp./wt.} = 2.7/(1 + e^{3.55 - 0.105t})$$

where t is the number of years after 1904. The asymptote is 2.7, which means that, if this prediction is correct, this factor will level off as it approaches 2.7 hp. per lb.

Trend of Pounds of Thrust per Pound of Weight for Jet Engines

The biological growth curves are continuous unless the environment is changed or a mutation occurs. In Fig. 7, the turbojet engine might be considered as a mutation of the reciprocating engine, because a new growth curve has been initiated. This new curve has a new asymptote.

It is already apparent that a fundamental advantage of the turbojet is that it is capable of producing high powers for its weight, and this advantage may be expected to continue to improve. To show this progress in terms more common to the jet engine, the ratio of sea-level static thrust to dry weight has been plotted in Fig. 8.

Have Specific Fuel Consumptions Changed?

From all of the available data, there has been practically no improvement in brake specific fuel consumptions. During the first World War, cruising specific fuel consumptions of between 0.45 and 0.5 lbs. per b.hp. per hr. were obtained, and these same figures prevailed during the last war.

At the present speeds, a comparable value for turbojet engines is about two or three times this value, which tends to offset the advantage in engine weight. This is the reason, of course, why turbojets have an advantage in short-range, high-speed aircraft but will have to await improved efficiencies and higher operating speeds

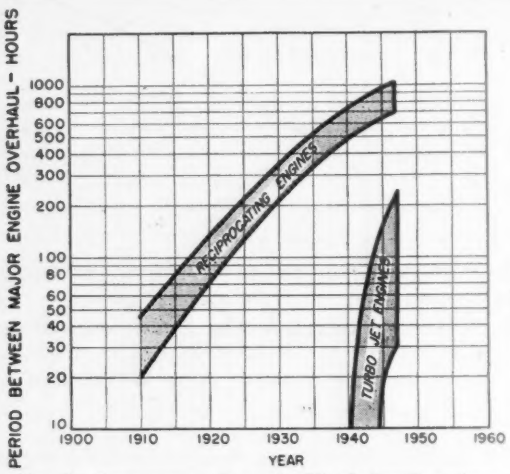

FIG. 9. Improvement in service life of aircraft engines.

before they can compete in long-range aircraft. In this regard, however, turbojets and propeller turbines will not remain static as reciprocating engines have, since they are operating considerably below stoichiometric mixtures and can still improve component efficiencies.

IMPROVEMENTS IN SERVICE LIFE OF ENGINES

In order to give the reciprocating engine manufacturers credit for their long hard years of effort and to show that this effort cannot be duplicated overnight by any new type of engine, the approximate hours between major overhauls have been plotted in Fig. 9. Although jet engines have made considerable progress, they still have a long way to go, and this factor is not being overlooked by operating personnel.

A LOOK AHEAD—THE EFFECT OF THE WAR YEARS

Past trends in aircraft engines which have been of importance to the aircraft manufacturers have been discussed. Because of the accelerating effect of the war, the industry finds itself faced with the question, "What is going to be our rate of progress now?" The answer, of course, is directly related to the future size and activity of the industry. On most of the graphs, two trend lines have been projected with a shaded or questionable area in between. The upper trend line represents an optimistic extension of our present rate of progress. The lower trend line represents a more pessimistic and, perhaps, realistic extrapolation. It is believed to be realistic because:

(1) There is already apparent a marked reduction in engineering and development work because of the reduced expenditures of the procuring agencies.

(2) There was a similar slackening of effort after World War I which did not reaccelerate for approximately 10 years. At that time we again appeared to follow along a basic trend line.

(3) Economists have noticed this same effect in other efforts and now believe that: "Regardless of the degree of disturbance, once the war 'explosion' has subsided and the disturbances recede, the previously prevailing trends and levels have usually been re-established in our economy. Previous wars did not, in themselves, alter basic underlying trends, insofar as our statistical data show them" (see reference 4, page 207).

However, if one attempts to look ahead, both of these possible trends must be carefully and cautiously considered. The final outcome must eventually be determined by the attitude of our Government and the conditions extant in our country and in the entire world. The fact that we may return to the basic trend line cannot be ignored. Aircraft manufacturers who guarantee airplane performance on horsepower or engine thrust based on the accelerated rates of progress may find themselves in trouble.

TIMING OF DIFFERENT DEVELOPMENTS

The relation between the reciprocating engine and the initial turbojet developments has been noted. It is interesting to speculate on the relative progress of other types of new engines.

Before presenting this estimate, the assumptions on which it will be based should be listed.

(1) We shall probably go through the speed of sound with research airplanes in the next 2 or 3 years. Fighters, attack airplanes, and bombers will achieve the same thing at different periods over the next 25 years.

(2) Propeller turbines and ducted fan turbines will replace reciprocating engines in slow load-carrying airplanes because of their lower specific weight.

(3) As the speeds of each type approach the speed of sound, the turbojet will replace even the propeller turbine and ducted fan turbine, since its fuel consumption (i.e.—propulsive efficiency) becomes more favorable in this speed region.

(4) Above about 1,000 m.p.h., the development of the turbojet will have to give way to the simpler ramjet.

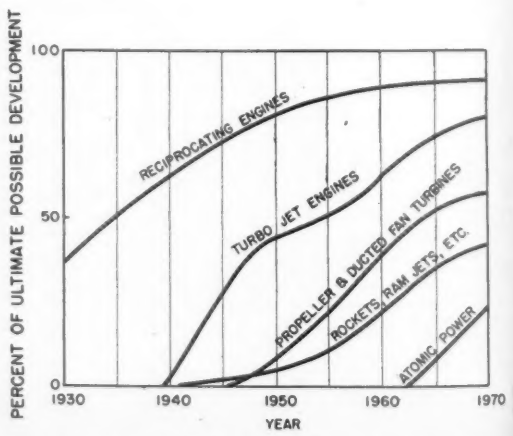

FIG. 10. Estimated timing of development of various types of aircraft power plants.

(5) Although rocket motors are being developed and used now, their real usefulness to man-carrying aircraft will be found in space ships.

(6) The advent of atomic power for aircraft will overshadow all other previous developments.

With these points in mind and remembering our past trends, Fig. 10 has been prepared to show an estimate of the future timing of different developments in aircraft power plants. This figure is of interest in visualizing the progress of each type, so that this factor may be evaluated in any comparative studies.

A Long Look Ahead

Professor Schumpeter[6] has gone back in history as far as records permit to study our industrial progress. He has noted that our periods of most marked advance seem to come in long-term cycles. These cycles were evident throughout modern history but became more distinct with the wave that included the Industrial Revolution. This wave started about 1780 to 1790. By about 1842, the cycle had again reached the low point and was again ready to accelerate. The next wave, which lasted until almost the end of the last century, included steam power and its accessories, such as the railroads, steamboats, etc. The present cycle was initiated with the discovery of X-rays, and the development of the automobile, the airplane, and of electricity. Professor Schumpeter calls these long-term waves "Kondratieffs" after a man who had earlier recognized their cyclic nature.

Is our present cycle beginning to draw to a close? If these long-term waves have anything like a uniform period, then it is due to end. Some of our leading scientists believe that scientific progress is not so spectacular as it was 20 or 30 years ago. Even the development of the atomic bomb was more a matter of the determination of constants than the propounding of a great scientific theory.

If future historians do look back on the next few years as the end of another great cycle, then it is interesting to speculate on how the aircraft industry will fit into this pattern.

Our speed progress already is being seriously hampered by compressibility effects, and there will be other obstacles, such as temperature-rise effects, as pointed out by Heinemann.[7]

In power-plant development, it is apparent that reciprocating engines, which made possible our initial developments, are approaching maturity. Although jet and turbine engines are now doing nicely, their efforts may appear to be greatly overshadowed by the advent of atomic power for aircraft in the coming upswing of the new cycle.

If the above view proves correct, the next 10 or 15 years may be uneventful, but they may be very interesting to the aircraft engineers. They will know that progress is slow and difficult, but they will recognize that they are laying the groundwork for a period that will view atomic-powered supersonic vehicles and space ships as commonplace.

References

[1] Grey, C. G. (and/or Bridgman, Leonard), *Jane's All the World's Aircraft;* Sampson Low, London, 1910–1945.

[2] Grey, C. G., *History of Combat Airplanes;* Norwich University, Norwich, Vt., December 1941.

[3] Wilkinson, Paul H., *Aircraft Engines of the World,* Revised Ed.; published by the author, N.Y., 1947.

[4] Dewey, Edward R., and Dakin, Edwin F., *Cycles—The Science of Prediction;* Henry Holt & Co., N.Y., 1947.

[5] Pearl, Raymond, *Studies in Human Biology,* Chapter XXIV, p. 576; Williams & Wilkins Co., 1924.

[6] Schumpeter, Joseph A., *Business Cycles, Theoretical, Historical and Statistical Analysis of the Capitalistic Process;* McGraw-Hill Book Co., N.Y., 1939.

[7] Heinemann, E. H., *High Speed Aircraft Developments,* given before A.S.M.E. National Aviation Meeting, Los Angeles, Calif., May 28, 1947.

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Summaries of current papers received for publication or presentation at I. A. S. meetings

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Preprints of these papers are not available at this time.

The Effects of Compressibility on the Two-Dimensional Subsonic Wind-Tunnel Constriction Correction

By

H. T. Epstein and L. U. Albers

University of Michigan

Relaxation methods were applied to the determination of the effects of compressibility on two-dimensional wind-tunnel interference. Calculations were made for a 10 per cent thick symmetrical section, both isolated and symmetrically placed between two walls, for ratios of chord to tunnel height C/H of 1 and 2. Flows at Mach Numbers of both 0 (incompressible flow) and 0.5 were obtained.

The incompressible velocities agreed well with those obtained by conformal mapping methods and the compressible velocities for the free-stream case were in satisfactory agreement with those given by Kaplan.

Evaluation of the wall interference showed that the effect of compressibility averaged linearly along the chord was about the same as that given by the linear-perturbation theories of Goldstein and Young and Allen and Vincenti. The variations along the chord were so great, however, that the use of these theories for correcting local quantities is problematical.

Range Performance of Turbojet Airplanes

By

Irving L. Ashkenas

Northrop Aircraft, Inc.

Expressions are developed for the maximum range of a turbojet-propelled airplane for three cruise flight conditions: constant altitude, varying altitude below 35,000 ft., and varying altitude above 35,000 ft. It is shown that maximum range is obtained by increasing the cruising altitude as the fuel is consumed and that this range is approximately given by the derived expressions even under conditions of nonoptimum operation. It is further shown that the thrust loading, T/W, is of prime importance, the range for a given airplane increasing with this parameter at a rate somewhere between the square root and the first power of this ratio.

Airplane configurations are derived which correspond to the aerodynamic optima for the cruise conditions investigated. It is indicated that, except for extreme cases, these configurations may be unreliable guides to optimum airplane designs.

A Critical Study of Aircraft Landing Gears

By

J. F. McBrearty

Lockheed Aircraft Corporation

This report contains some of the results of a continuing study on the behavior of aircraft landing gears. This study was prompted by the general awareness that landing gears are a principal source of accidents and troubles throughout the aviation industry and by the desire to determine, if possible, technological advancement in this area for future aircraft. Some of the findings to date appear of sufficient importance to warrant presentation at this time.

Factual data are presented showing that, exclusive of accidents due to crew error, weather, or unknown causes, landing-gear failures have been consistently responsible for more commercial and military accidents than all the rest of the structure combined; that landing-gear structural failures are predominantly caused by drag loads; that this is in spite of steady increases in design loads; and that a large number of these failures have occurred in "normal" landings. Some statistical data are available to show that design conditions are amply severe and, in fact, are seldom realized even in "hard" landings. Strength diagrams show that landing-gear strengths on comparable aircraft are about equivalent and are very high. Behavior characteristics are also shown to be similar among comparable aircraft.

In a critical search for an underlying cause of excessive loads in apparently normal landings with aircraft of all types, Lockheed Constellation experience is utilized. Various possible explanations, such as the general strength level, fatigue, shock, strut characteristics, extreme ground friction, and structural deflections, are considered. These factors are found to aggravate and contribute to the problem but they do not explain service failures. The fundamental cause is deduced to be dynamic overloading of landing gears resulting from critical rates of application of wheel spin-up drag forces, which critical rates have a random probability of occurrence on any aircraft unless the motion is suitably damped. Some possible solutions are discussed, and hydraulic damping of horizontal wheel motion is advocated.

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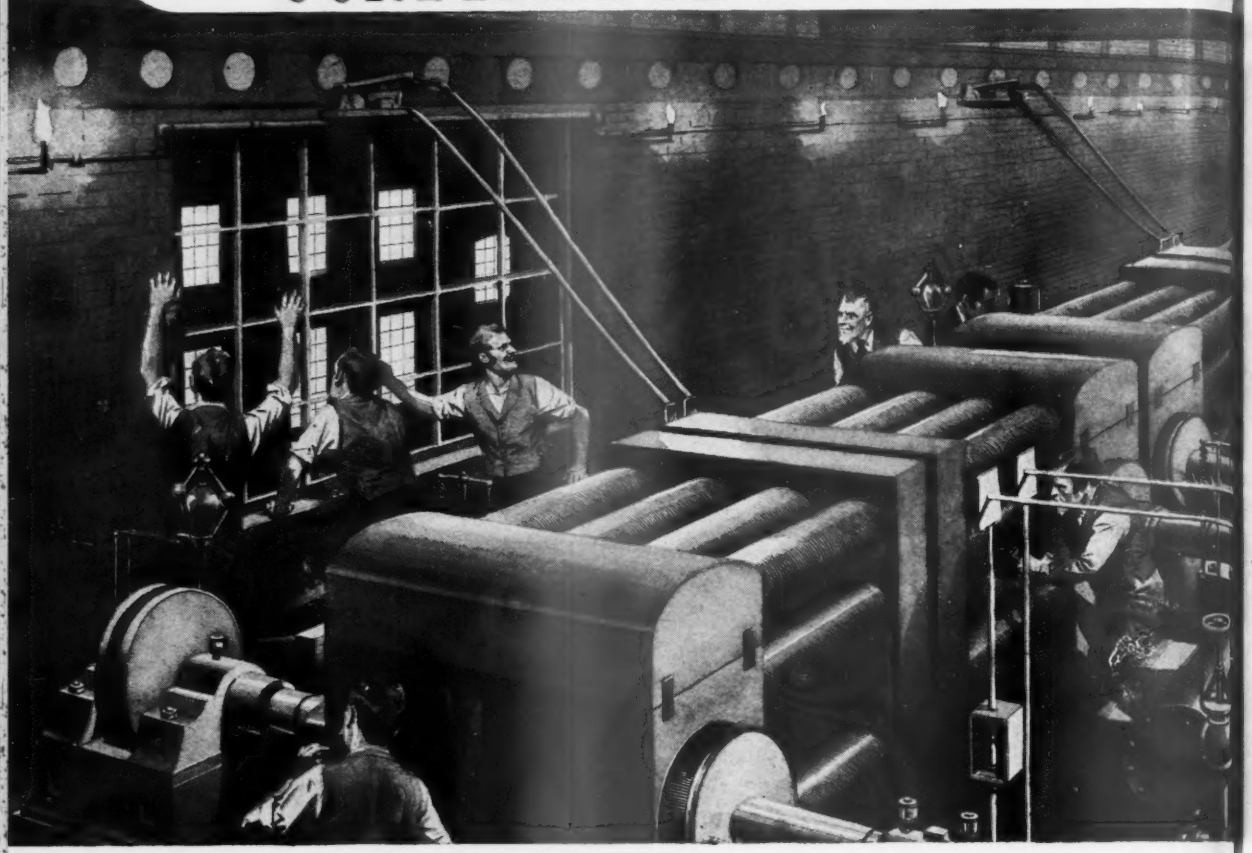

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Aerodynamics

Aerodynamic Performance of Delta Wings at Supersonic Speeds. A. E. Puckett and H. J. Stewart. *Journal of the Aeronautical Sciences*, Vol. 14, No. 9, October, 1947, pp. 567–578, figs. 7 references. (*See* AER 3/47:36.)

Pressure Distributions over Bodies of Revolution for Axial Flow. M. Brand. (*Göttingen, Aerodynamische Versuchsanstalt, UM/3206*, December 30, 1944.) *U.S., Navy Department, David Taylor Model Basin, Translation No. 220*, April, 1947. 49 pp., figs. 2 references.

The method of singularities of E. Riegels and M. Brand is used to compute the pressure distributions on 59 bodies of revolution and 12 half-bodies in axial flow. The nose radius, the thickness distribution, and the trailing-edge angle were varied, but the fineness ratio was assumed to be practically constant throughout at 1:5. Examples are given for bodies with assigned contours. The effects of other fineness ratios on pressure distribution are examined.

Calculation of the Pressure Distribution on Bodies of Revolution in the Subsonic Flow of a Gas. I—Axially Symmetrical Flow. Herbert Bilharz and Ernst Hölder. (*ZWB/FB/1169/1*, January 15, 1940.) *U.S., N.A.C.A., Technical Memorandum No. 1153*, July, 1947. 31 pp., figs. 2 references.

A method of computing the velocity and pressure distribution. The differential equation for the velocity potential of a compressible fluid motion is linearized in the conventional manner and then put in the form $\Delta\bar{\phi} = 0$ by affine transformation. The resulting expression represents the velocity potential of a fictitious incompressible flow. A constant superposition of sources by section is obtained for this flow. The imposed boundary conditions yield a differential equation for the "pseudo stream function" which must be fulfilled for as many points on the contour as there are source lengths assumed. In this way, the problem of defining the source intensities is reduced to the solution of an inhomogeneous equation system. The pressure distribution is determined from Bernoulli's equation and the adiabatic equation of state. The pressure distributions in compressible and incompressible media are compared in a model problem.

Some Considerations of an Airfoil in an Oscillating Stream. J. Mayo Greenberg. *U.S., N.A.C.A., Technical Note No. 1372*, August, 1947. 48 pp., figs. 8 references.

The velocity potential, lift force, moment, and propulsive forces on a two-dimensional airfoil in a stream with periodically varying angle of attack were derived theoretically. A stationary incompressible potential-flow theory was used which included the effect of the sheet of vortexes shed from the trailing edge. The results indicated that the amplitude of vibration of an airfoil in an oscillating stream is critically dependent on the stiffness of the airfoil and the position of its torsion axis. Amplitudes of vibration are smaller when the axis is ahead of the quarter-chord point and larger when behind it. Because of the nonuniform response of a hinged airfoil, its use in the measurement of the angular variations in an oscillating stream must be restricted to low frequencies in which the response approaches unity.

Theoretical Study of Air Forces on an Oscillating or Steady Thin Wing in a Supersonic Main Stream. I. E. Garrick and S. I. Rubinow. *U.S., N.A.C.A., Technical Note No. 1383*, July, 1947. 44 pp., figs. 21 references.

The development of an expression for the velocity potential in the case where there is independence of action of the top and bottom surfaces and no reflecting surfaces in the field. The treatment is based on the linearized theory obtained by considering only small disturbances in an ideal fluid moving at a uniform supersonic speed. The theory is equivalent to finding certain solutions of the wave equation in three dimensions with respect to a moving coordinate system. The method is illustrated by application to examples for both the steady and the oscillating case, which include swept wings and rectangular and triangular plan forms.

Theoretical Air-Load and Derivative Coefficients for Rectangular Wings. W. Prichard Jones. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2142*, February, 1943. British Information Services, New York. $2.75.

Complete sets of flexure-torsion air-load and derivative coefficients are calculated for thin rectangular wings that have aspect ratios of four and six and that have representative distortion modes. The method described is based on vortex sheet theory and on the assumption that the chordwise distributions of vorticity, which induce particular distributions of normal velocity in two-dimensional theory, also induce proportional velocity distributions at each chordwise section of the finite wing. Results correspond to an infinite value of the Reynolds Number. Wind-tunnel measurements of the pitching-damping derivative of a rigid airfoil show little variation with the Reynolds Number when it is less than 10^6 and agree well with the values predicted by the present theory. The slope of the lift curve as calculated by the present method for a rectangular airfoil of aspect ratio six in steady motion is in good agreement with representative ex-

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perimental values. The corresponding value given by Glauert's lifting-line theory is about 5 per cent higher.

Theoretical Determination of the Pressure Distribution on a Finite Wing in Steady Motion. W. Prichard Jones. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2145*, May, 1943. 13 pp. 11 references. British Information Services, New York. $0.90.

A general method for the determination of the pressure distribution of a finite wing of any plan form in steady motion. It is assumed that the vorticity distribution over the wing is made up of simple constituent vorticity distributions that are combined linearly to make the corresponding induced velocity distribution satisfy the tangential flow conditions. The double integral expression for the normal and induced velocity due to any vorticity distribution is reduced to a single integral that can be evaluated to the desired accuracy. An approximate method which simplifies the numerical work and gives greater accuracy than Glauert's lifting-line theory is given. For unswept wings of normal aspect ratio it gives good agreement with the experimental evidence available. The methods can be generalized for calculations of the aerodynamic forces acting on wings in non-uniform motion.

Some Notes on Aerodynamic Derivatives. W. J. Duncan. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2115*, April, 1945. 10 pp. 10 references. British Information Services, New York. $0.70.

The two-dimensional derivatives for a thin airfoil performing any small exponential sinusoidal motion can be obtained from the derivatives for a real divergence. All that is required is the values of the modified Bessel functions K_0 and K_1 for complex arguments. Quasistatic derivatives are calculated from the lift slope for steady incidences to determine their applicability in two- and three-dimensional motion. It was found that they may be used for the phugoid but may be somewhat in error for the rapid longitudinal oscillations of an aircraft. The use of derivatives that are independent of time is examined and attention is drawn to the special properties of the quarter and three-quarter chord points.

Effects of Sweepback on Boundary Layer and Separation. Robert T. Jones. *U.S., N.A.C.A., Technical Note No. 1402*, July, 1947. 8 pp., diagrs. 6 references.

A discussion of the viscous flow produced by an infinite cylinder moving obliquely. The Navier-Stokes equations with given boundary conditions show that the flight pattern and pressure disturbances in planes at right angles to the cylindrical axis are determined by the component of velocity of the cylinder in these planes. In the case of a yawed or swept wing of high aspect ratio, certain boundary-layer and separation phenomena are thus determined independently by the crosswise component of velocity. The effect of sweepback is to increase the area of stable laminar flow and to decrease the lift coefficient at which flow separation occurs.

The Effect of Compressibility on the Growth of the Laminar Boundary Layer on Low-Drag Wings and Bodies. H. Julian Allen and Gerald E. Nitzberg. *U.S., N.A.C.A., Technical Note No. 1255*, July, 1947. 20 pp., figs. 7 references.

Pressure distribution measurements obtained from wind-tunnel tests were used to determine the thickness of the boundary layer. The results were in close agreement with calculations obtained from a formula that includes the effects of compressibility and aerodynamic heating. Low drag coefficients can be maintained to considerably large Reynolds Numbers if the Reynolds Numbers are associated with high rather than low Mach Numbers.

The Stability of the Laminar Boundary Layer in a Compressible Fluid. Lester Lees. *U.S., N.A.C.A., Technical Note No. 1360*, July, 1947. 168 pp., figs., tables. 24 references.

The continuation of an investigation to determine how the phenomena of laminar instability and transition to turbulent flow are modified when the fluid velocities and temperature variations in the boundary layer become so large that the compressibility and conductivity of the fluid can no longer be neglected. The viscosity as well as the compressibility and heat conductivity of the gas are taken into account. The limits of stability of the laminar boundary layer in a viscous conductive gas and the

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destabilizing influence of viscosity at very large Reynolds Numbers are calculated. An estimate of the minimum critical Reynolds Number, the actual limit of stability, is obtained and serves as a criterion for the influence of free-stream Mach Number and thermal conditions at the solid surface on laminar stability. From this stability criterion and from equations of mean motion, the effect of adding heat to the fluid through the solid surface is shown to reduce the minimum critical Reynolds Number and to destabilize the flow in comparison with the flow over an insulated surface at the same Mach Number. Withdrawing heat through the solid surface has the opposite effect. Detailed calculations of the curves of inverse wave length against Reynolds Number for the neutral boundary-layer disturbances in ten representative cases of insulated and noninsulated surfaces show that at subsonic speeds, also, the quantitative effect on stability of the thermal conditions at the solid surface is large and in accord with this criterion. When the free-stream velocity is supersonic, transition never occurs if the rate of heat withdrawal from the fluid through the solid surface reaches or exceeds a certain critical value, at which value the minimum critical Reynolds Number approaches infinity.

A Review of Boundary-Layer Literature. Neal Tetervin. *U.S., N.A.C.A., Technical Note No. 1384*, July, 1947. 38 pp., figs. 48 references.

The various methods of calculating laminar and turbulent boundary layers are summarized concisely. The presentation is not mathematical, but the information given is exact or, at least, approximate. Sufficient information is not given for the solution of specific problems, but theoretical background and the methods of calculation are described in enough detail to serve as a guide to further reading on the general subject and on its specific applications. The summary is confined to cases for which the physical properties of the fluid are constant—that is, to incompressible flow, with no temperature effects.

The Development of Turbulent Boundary Layers. H. C. Garner. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2133*, June, 1944. 21 pp., figs. British Information Services, New York. $1.35.

A method of calculating the development of a turbulent boundary layer up to the point of separation. From the analysis of data for the turbulent boundary layers along airfoils, von Doenhoff derived an empirical equation for the rate of growth of the shape of the parameter H, which, together with the momentum thickness, determined satisfactorily the velocity distribution in a turbulent layer. A similar empirical equation, when used with Howarth's form of the momentum equation of the boundary layer and a power law for the skin friction, leads to a considerably simplified calculation. The report describes this method and discusses the initial conditions at the onset of the fully turbulent layer. The details of the calculations by von Doenhoff's method are given in appendixes.

Investigations on Reductions of Friction on Wings, in Particular by Means of Boundary Layer Suction. Werner Pfenninger. (*Zurich, Eidgenössische Technische Hochschule, Institut für Aerodynamik, Mitteilungen Nr. 13*, 1947).) *U.S., N.A.C.A., Technical Memorandum No. 1181*, August, 1947. 148 pp., illus. 86 references.

A report on the reduction of frictional drag by maintaining a more extended laminar boundary layer, particularly with the aid of boundary-layer suction. The first chapters treat publications in this field, the causes of the boundary-layer transition, and a few laminar profiles without boundary-layer suction. Next, tests with laminar suction profiles are described. The behavior of the suction slots for laminar boundary-layer suction was examined separately.

Untersuchungen über Reibungsverminderungen an Tragflügeln, Insbesondere mit Hilfe von Grenzschichtabsaugung. Werner Pfenninger. *Zurich, Eidgenössische Technische Hochschule, Institut für Aerodynamik, Mitteilungen Nr. 13*, 1947.) Zurich, Verlag AG. Gebr. Leemann & Co., 1947. 108 pp., illus. 86 references. Sw. fr. 14.-. (*See* preceding abstract.)

The Effect of the Boundary Layer and Wake on the Flow Past a Symmetrical Aerofoil at Zero Incidence. I—The Velocity Distribution at the Edge of, and Outside the Boundary Layer and Wake. J. H. Preston. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2107*, July, 1945. 21 pp., figs. 9 references. British Information Services, New York. $1.35.

The doublet distribution method is used to compute the effect of the boundary layer on the flow about a simple Joukowski airfoil for which the boundary-layer characteristics had been determined by experiment. The calculated values for the velocity distribution at the edge of the boundary layer agree with the experimental values. Except at the trailing edge, they differ little from those values computed with the boundary layer absent. An apparent discrepancy between theory and experiment in the wake is traced to interference between the boundary layer of the wing and that of the tunnel wall. This indicates that discrepancies in the ordinary potential flow theory, which were in the past attributed to boundary-layer effects, have, in reality, been caused by mixing of the airfoil and the tunnel boundary layers. Airfoil-tunnel blockage can be eliminated by flexible walls, but the blockage produced by boundary-layer mixing cannot be removed and causes a static pressure drop in the wake.

Boundary Layer Control May Offer Safety Increase. *Aviation Week*, Vol. 47, No. 7, August 18, 1947, pp. 34, 35. 10 references.

A digest of the results of current research on boundary-layer control. The relative advantages of removal of boundary layer by sucking and by blowing, wing and slot design data, and the range of application of this technique are discussed.

Mean Value and Correlation Problems Connected with the Motion of Small Particles Suspended in a Turbulent Fluid. Tchen Chan-Mou. (*Delft, Technische Hogeschool, Laboratorium voor Aero- en Hydrodynamica, Mededeling No. 51.*) The Hague, Martinus Nijhoff, 1947. 125 pp., figs. (In English.)

Since suspended foreign particles are often used as an indicator by which to measure the characteristics of the turbulence of a fluid, this study in statistical mathematics is of practical as well as theoretical interest. Theoretical investigation of the movements of a great number of particles, each of which is subjected to the irregular influence of the elements of a volume of a fluid, requires the determination of the properties common to a multitude of particles. These properties are obtained by developing equations for the simultaneous behavior of members of a certain group and, by calculating mean values over a longer interval of time, for a single particle. From the expressions and the values thus arrived at, an equation is derived for the diffusion of the particles in a fluid.

Cases of Motion in a Gas with Non Colliding Molecules. J. M. Burgers. (*Delft, Technische Hogeschool, Laboratorium voor Aero- en Hydrodynamica, Mededeling No. 50.*) *K. Nederlandsche Akademie van Wetenschappen, Proceedings*, Vol. 50, No. 6, 1947. 11 pp., figs. (Reprint.) (In English.)

An examination of the problems of motion for extremely rarefied gases. When the walls containing the gas have a variable

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

The North American XP-86, U.S. Air Forces' first swept-wing fighter, which will be used to explore the tactical possibilities of swept-wing designs.

velocity comparable to that of the molecules, even the diffuse deflection of the molecules from the walls produces a velocity distribution pattern which differs appreciably from the velocity distribution according to Maxwell. The pattern must be expressed by a direct use of the kinetic picture. Formulas are derived for the velocity distribution at a point on the wall, for a given point in space at a given instant, and for the case where the walls are moving according to the parabolic law.

Aerodynamical Problems Suggested by a Case of Motion of Interstellar Gas Clouds. J. M. Burgers. (*Delft, Technische Hogeschool, Laboratorium voor Aero- en Hydrodynamica, Mededeling No. 49.*) *K. Nederlandsche Akademie van Wetenschappen, Proceedings*, Vol. 50, Nos. 3, 4, 5, 1947. 32 pp., figs. (Reprint.) (In English.)

Preliminary Investigation at Low Speed of Downwash Characteristics of Small-Scale Sweptback Wings. Paul E. Purser, M. Leroy Spearman, and William R. Bates. *U.S., N.A.C.A., Technical Note No. 1378*, July, 1947. 55 pp., illus. 9 references.

The results of tests at low speed to determine down-wash characteristics. At high angles of attack, large variations in the rate of change of down-wash angle with angle of attack occurred for the higher tails and shorter tail lengths behind each of the wings in the wing-tail combinations tested. Large changes in longitudinal stability of the wing-tail combinations resulted. Extending the tail length and lowering the tail to a position near the extended chord line generally caused a decrease in the rate of change of down-wash angle with angle of attack and improved the stability at high lift coefficients. Increasing the wing aspect ratio caused a like improvement. Increasing the ratio of the wing-root chord to tip chord had the opposite effect. Values of down-wash angle computed from design charts for unswept wings agreed fairly well with experimental data at low lift coefficients, provided that the computations were based on the aspect ratio and span of an unswept wing having the same panels as the sweptback wing.

Charts for the Determination of Supersonic Air Flow Against Inclined Planes and Axially Symmetric Cones. W. E. Moeckel and J. F. Connors. *U.S., N.A.C.A., Technical Note No. 1373*, July, 1947. 35 pp., figs. 10 references.

In order to predict the conditions at the surface of an obstacle in the stream or in the field between the shock and the surface, it is necessary to know the relation between the geometry of the obstacle and the angle of the resulting shock. This relation has been determined for the surface of an inclined plane and an axially symmetric cone. In convenient and complete form, charts provide the theoretical relations required to determine the supersonic flow against these two types of obstacles and the conditions immediately behind any shock when its direction is known. A chart is also given for the Prandtl-Meyer relations for supersonic flow around corners.

The Separation of Flow Due to Compressibility Shock. A. Weise. (*Technische Berichte*, Band 10, Heft 2, 1943, pp. 59–61.) *U.S., N.A.C.A., Technical Memorandum No. 1152*, July, 1947. 9 pp., illus.

An explanation of the theory of branching or forking of compressibility shocks. An analysis of this behavior explains the energy losses that have been observed on airfoils and in diffusers. The use of boundary-layer suction has prevented the formation of forks and the consequent energy losses.

Equations for Adiabatic but Rotational Steady Gas Flow Without Friction. Manfred Schäfer. (*Dresden, Technische Hochschule, Lehrstuhl für Technische Mechanik, Archiv. Nr. 44/1.*) *U.S., N.A.C.A., Technical Memorandum No. 1187*, August, 1947. 23 pp.

When a compression shock occurs in adiabatic steady flow, the gas ceases to behave adiabatically during the shock but returns, after the shock, to its original behavior. Although the flow is isentropic both before and after the shock, the adiabatic equation assumes a different constant in each case. In order to obtain an equation for nonisentropic-adiabatic flow, differential equations are derived from the equations of motion, continuity, adiabatic flow, and energy, which express the velocity field of the fluid in terms of velocities only. Nondimensional magnitudes are introduced and five scalar equations are obtained which contain the three cartesian coordinates and the stream function as unknowns. After these equations have been applied to two-dimensional flow, cylindrical coordinates are introduced and a differential equation is obtained for the velocity field in flow that is rotationally symmetrical.

Effect of Compressibility on the Distribution of Pressures over a Tapered Wing of NACA 230-Series Airfoil Sections. E. O. Pearson, Jr. *U.S., N.A.C.A., Technical Note No. 1390*, July, 1947. 35 pp., illus. 6 references.

Pressure-distribution measurements to determine the effects of Mach Number on maximum lift and spanwise load distribution. Peak values of minimum pressure coefficients were found to correspond to local Mach Numbers of 1.2–1.4. Local Mach Numbers generally continued to increase with increasing stream Mach Number beyond that point at which peak minimum pressure coefficients occurred. In general, no noticeable indication of flow separation was observed until the stream Mach Number corresponding to the attainment of peak pressure coefficients had been well exceeded. At angles of attack very near those corresponding to the low-speed stall, there was some indication that the flow about the wing broke down when the critical pressure coefficient (local Mach Number of 1.0) was reached. The measured rate of increase with Mach Number of section normal-force coefficient at subcritical values of Mach Number was in excellent agreement with that predicted from the small-disturbance theory. Large differences between the theoretical and experimental results occurred at high supercritical speeds. The method used for calculating the chordwise pressure distribution gave results in satisfactory agreement with experiment for the purpose of structural design at Mach Numbers up to the critical.

Distribution of Wave Drag and Lift in the Vicinity of Wing Tips at Supersonic Speeds. John C. Evvard. *U.S., N.A.C.A., Technical Note No. 1382*, July 1947. 33 pp., diagrs. 9 references.

The point-source-distribution method of calculating the aerodynamic coefficients of the wing is extended to include the effect of the region between the wing boundary and the foremost Mach wave from the leading edge. By use of a source distribution external to the wing, the interaction of the two wing surfaces may be isolated. In this manner the pressure distribution in the vicinity of the wing tip as well as the effects of profile shape, angles of attack and yaw, and aspect ratio, may be calculated for a series of finite wings.

Estimated Lift-Drag Ratios at Supersonic Speed. Robert T. Jones. *U.S., N.A.C.A., Technical Note No. 1350*, July, 1947. 46 pp., illus. 17 references.

The fuel expenditure per mile of flight need not increase with speed as long as the lift-drag ratio of the aircraft is maintained. The lift-drag ratios at supersonic speeds are estimated for aircraft with swept wings to determine an efficient configuration. Ratios greater than 10 to 1 can be maintained up to a Mach Number of 1.4 by the use of large angles of sweepback and high aspect ratios. As the speed increases in the supersonic ranges, the attainable lift-drag ratios decrease, and the gain effected by sweepback appears to diminish.

The Effects of Aerodynamic Heating and Heat Transfer on the Surface Temperature of a Body of Revolution in Steady Supersonic Flight. Richard Scherrer. *U.S., N.A.C.A., Technical Note No. 1300*, July, 1947. 27 pp., figs. 11 references.

A method is presented for determining the convective cooling requirements in the laminar boundary-layer region for any body of revolution in steady supersonic flight. The cooling requirements of a body with a fineness ratio of 10, selected as representative of present trends in rocket design, were calculated for a range of Mach Numbers from 1.2 to 3.0 at altitudes between 40,000 and 120,000 ft. The requirements were found to be small but increased rapidly with the Mach Number. Results also indicated that the cooling of a body in high-speed flight will cause a reduction in the friction drag of the body.

Drag Measurements on NACA 2218 Section at Compressibility Speeds for Comparison with Flight Tests and Theory. H. H. Pearcey. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2093*, April, 1943. 9 pp., illus. 17 references. British Information Services, New York. $0.70.

The rapid rise in drag did not begin as abruptly in the flight tests as in the tunnel tests, but the agreement between the Mach Numbers at which it occurred was good. For the four incidences at which the tunnel measurements were made, the drag did not rise appreciably until Mach Numbers above the theoretical critical were reached.

High-Speed Tests of an Airfoil Section Cambered to Have Critical Mach Numbers Higher Than Those Attainable with a Uniform-Load Mean Line. Donald J. Graham. *U.S., N.A.C.A., Technical Note No. 1396*, August, 1947. 18 pp., illus. 2 references.

The test results indicate that most of the characteristics of the modified NACA $66_{(109)}$-210 airfoil are essentially the same as those of the NACA 66-210 ($a = 1.0$) airfoil. The especially cambered airfoil exhibits slightly more favorable lift- and drag-divergence characteristics than the NACA 66-210 ($a = 1.0$) airfoil. The former has divergence Mach Numbers approximately 0.01 higher than those of the latter over most of the useful lift-coefficient range. This small difference roughly corresponds to the difference in the critical speeds of the two airfoil sections.

Theoretical and Experimental Data for a Number of NACA 6A-Series Airfoil Sections. Laurence K. Loftin, Jr. *U.S., N.A.C.A., Technical Note No. 1368*, July, 1947. 43 pp., figs. 5 references.

The thin trailing-edge cusp has been removed from a number of NACA 6-series basic thickness forms and the sides of the airfoil sections made straight from approximately 80 per cent chord to the trailing edge. The modified forms are designated the NACA 6A-series. The ordinates and the theoretical pressure-distribution data are given for NACA 6A-series basic thickness forms covering a range of thickness ratios extending from 6 to 15 per cent and a range of positions of minimum pressure extending from 30 to 50 per cent chord. The aerodynamic characteristics of seven NACA 6A-series airfoil sections are analyzed and compared with similar data for NACA 6-series airfoil sections of comparable thickness and design lift coefficient. The section minimum-drag and maximum-lift characteristics of the two series are essentially the same. The position of the aerodynamic center and the lift-curve slope of smooth NACA 6A-series airfoil sections appear to be independent of airfoil thickness ratio in contrast to the trends shown by NACA 6-series sections.

Lift and Drag of Wings with Small Span. F. Weinig. (*ZWB/FB/1665*, September 8, 1945.) *U.S., N.A.C.A., Technical Memorandum No. 1151*, August, 1947. 25 pp., figs. 16 references.

The induced drag coefficient for a wing of small span may be determined accurately when a three-dimensional array of free vortexes, which corresponds to the angle of attack, is taken as a base, and a finite flow domain is coordinated to each wing element. This slight modification of the lifting-line theory offers an explanation for the rapid nonlinear increase of the lift coefficient and the relatively small induced drag for increasing angle of attack which are given by the unmodified theory.

Boundary-Layer Transition on the N.A.C.A. 0012 and 23012 Airfoils in the 8-Foot High-Speed Wind Tunnel. John V. Becker. *U.S., N.A.C.A., Advance Confidential Report* (*Wartime Report No. L-682*), January, 1940. 38 pp., illus. 15 references.

Investigation of Surface Irregularities on an NACA 63(420)-416, a = 1.0 Airfoil Section for The Glenn L. Martin Company Design 195. Albert L. Braslow. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. L-534*), October, 1943. 24 pp., illus. 1 reference.

Lift and Drag Tests of Three Airfoil Models with Fowler Flaps Submitted by Consolidated Aircraft Corporation. Ira H. Abbott and Harold R. Turner, Jr. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. L-677*), December, 1941. 22 pp., illus.

High-Speed Wind-Tunnel Tests of Semispan Horizontal Tails with Fabric-Covered and Metal-Covered Elevators for a Bomber Airplane. Albert L. Erickson and Warren H. Nelson. *U.S., N.A.C.A., Memorandum Report No. A4L18* (*Wartime Report No. A-83*), December, 1944. 60 pp., illus. 6 references.

High-Speed Wind-Tunnel Tests of an NACA 16-009 Airfoil Having a 32.9-Percent-Chord Flap with an Overhang 20.7 Percent of the Flap Chord. David B. Stevenson and Robert W. Byrne. *U.S., N.A.C.A., Technical Note No. 1406*, August, 1947. 38 pp., illus. 8 references.

Wind-Tunnel Investigation of the NACA 654-421 Airfoil Section with a Double Slotted Flap and Boundary-Layer Control by Suction. John H. Quinn, Jr. *U.S., N.A.C.A., Technical Note No. 1395*, July, 1947. 27 pp., illus. 3 references.

Aerodynamic Data for a Wing Section of the Republic XF-12 Airplane Equipped with a Double Slotted Flap. Jones F. Cahill. *U.S., N.A.C.A., Memorandum Report No. L6A08a* (*Wartime Report No. L-544*), January, 1946. 23 pp., figs. 1 reference.

Determination of the Damping Moment in Yawing for Tapered Wings with Partial-Span Flaps. Sidney M. Harmon. *U.S., N.A.C.A., Advance Restricted Report No. 3H25* (*Wartime Report No. L-395*), August, 1943. 19 pp., figs. 5 references.

Wind-Tunnel Investigation of Perforated Split Flaps for Use as Dive Brakes on a Rectangular NACA 23012 Airfoil. Paul E. Purser and Thomas R. Turner. *U.S., N.A.C.A., Advance Confidential Report* (*Wartime Report No. L-445*), July, 1941. 45 pp., illus. 3 references.

Measurement of Individual Aileron Hinge Moments and Aileron Control Characteristics of a P-40F Airplane. R. Fabian Goranson. *U.S., N.A.C.A., Memorandum Report No. L5A29a* (*Wartime Report No. L-649*), January 1945. 43 pp., illus. 1 reference.

High-Speed Aerodynamic Characteristics of a Four-Engined Transport Airplane as Determined from Tests of a 0.075-Scale Model. Robert H. Barnes. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. A-67*), January, 1944. 20 pp., illus. 1 reference.

Tests of a $^1/_{14}$-Scale Powered Model of the XB-36 Airplane in the Langley 19-Foot Pressure Tunnel. I—Stalling Characteristics and Aileron Effectiveness of Several Wing and Flap Arrangements. S. R. Alexander and James C. Sivells. *U.S., N.A.C.A., Memorandum Report No. L5B23* (*Wartime Report No. L-624*), February, 1945. 70 pp., illus. 5 references.

The Effect of Mach Number on the Aerodynamic Characteristics of a Single-Engine Pursuit Airplane as Determined from Tests of a $^1/_5$-Scale Model. Robert C. Robinson and Henry Jessen. *U.S., N.A.C.A., Memorandum Report No. A5E03* (*Wartime Report No. A-76*), May, 1945. 29 pp., illus. 3 references.

Searching Drag Studies Check Speed Impeders. III–VII. *Aviation Week*, Vol. 47, Nos. 4, 7, 10–12, July 28, August 18, September 8, 15, 22, 1947; pp. 29; 25; 40; 26; 25; illus., diagrs.

III. Diagrams showing modification of two duct inlets for best pressure recoveries at both low and high lift coefficients. **IV.** Three studies of duct inlets. Design modifications resulted in increased total-pressure recovery and decreased drag. **V.** Landing gear installations. **VI.** Five exhaust-stack installations. **VII.** Horizontal and vertical tail surfaces. Tail-wheel well and arresting hook housing.

Extended Applications of the Hot-Wire Anemometer. Stanley Corrsin. *The Review of Scientific Instruments*, Vol. 18, No. 7, July, 1947, pp. 469–471. 8 references.

The use of the hot-wire anemometer for the measurement of the mean velocities of flowing liquids is extended to include the measurement of temperature fluctuation level in turbulent flow with heat transfer and to determine the mean relative concentration in the mixing of two gases of different thermal characteristics. The instantaneous response of a hot wire in turbulent flow during this mixing has been computed. This permits the measurement of

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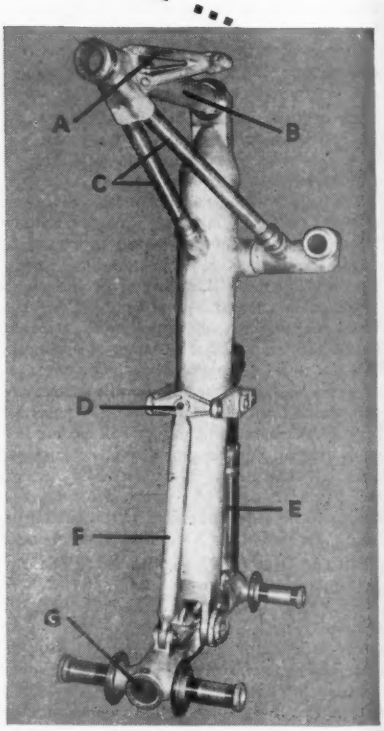

Cleveland Pneumatic Tool Company, producer of landing gear assemblies for the B-36, use Type 4340 Nickel-chromium-molybdenum steel for the following major parts: A—Jack Lever, B—Pivot Tube, C—Drag Braces, D—Cross Beam, E—Aerol, F—Fixed Link, G—Axle Beam.

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concentration fluctuation level as well as concentration-velocity correlation.

Preliminary Vibration and Flutter Studies on P-47 Tail. Theodore Theodorsen. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-654)*, August, 1943. 34 pp., illus.

Drag and Propulsive Characteristics of Air-Cooled Engine-Nacelle Installations for Two-Engine Airplanes. Herbert A. Wilson, Jr., and Robert R. Lehr. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-428)*, December, 1940. 33 pp., illus. 6 references.

An Investigation of Cowl-Flap and Cowl-Outlet Designs for the B-29 Power Plant Installation. DeMarquis D. Wyatt and E. William Conrad. *U.S., N.A.C.A., Memorandum Report No. E5K30a (Wartime Report No. E-206)*, January, 1946. 39 pp., illus. 5 references.

Comparisons of Theoretical and Experimental Lift and Pressure Distributions on Airfoils in Cascade. S. Katzoff, Harriet E. Bogdonoff, and Howard Boyet. *U.S., N.A.C.A., Technical Note No. 1376*, July, 1947. 19 pp. figs. 7 references.

The theoretical lift coefficients and the velocity distributions for cascades of turbine and blower blades with the NACA 6-series airfoils were found to be much larger than experimental values. Modifications of the basic methods of calculation were made by which the lift coefficients were reduced to the experimental values. Velocity distributions could then be compared for the same lift coefficients. The various comparisons indicated that the aspect ratios of the blades in the cascade tests could have been too small to avoid pronounced end effects, and that the pressure distribution on the blades of an actual blower might be appreciably different from that predicted from cascade tests.

Performance of an Axial-Flow Compressor Rotor Designed for a Pitch-Section Lift Coefficient of 1.20. L. Joseph Herrig and Seymour M. Bogdonoff. *U.S., N.A.C.A., Technical Note No. 1388*, July, 1947. 18 pp., figs. 3 references.

Rotating tests of the compressor showed that the increase in design loading gave increased pressure rise per stage and maintained a peak efficiency of 96 per cent and a good operating range. Deviation of peak efficiency from the design point indicated that optimum performance would be obtained by using sections of higher camber at lower angles of attack to fulfill the design conditions. At a solidity of 1.0, an average lift coefficient of at least 1.2 can be used with high efficiency, and maximum lift coefficients above 1.4 are indicated. Extreme leading-edge roughness caused a 3.5 per cent decrease in efficiency and an 11 per cent decrease in static-pressure rise at design conditions.

Numerical Evaluation of Mass-Flow Coefficient and Associated Parameters from Wake-Survey Equations. Norman F. Smith. *U.S., N.A.C.A., Technical Note No. 1381*, August, 1947. 37 pp., figs. 2 references.

A method by which to determine the characteristics and flow quantities of internal flow systems. For isoenergic flows, the point mass-flow coefficient is shown to be an explicit function of the free-stream Mach Number, the static-pressure, and the total-pressure-loss coefficients at the measurement station. The equations have also been evaluated for flows in which mechanical or thermal energy is added. The charts obtained by this method offer a means by which the mass-flow coefficient, inlet-velocity ratio, and mass-flow rate can be quickly evaluated in a few steps. The measured value of the static-pressure coefficient, the total-pressure-loss coefficient, and the free-stream Mach Number must be known. The fundamental principles used in this method may be applied to the measurement of flow from jet-propulsion units if the mass of the fuel and the change in the value of the ratio of specific heats is taken into consideration.

Analysis of Heat and Compressibility Effects in Internal Flow Systems and High-Speed Tests of a Ram-Jet System. John V. Becker and Donald D. Baals. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-535)*, September, 1942. 92 pp., illus. 8 references.

Air Transport

Airline Outlook. C. R. Smith. *Air Affairs*, Vol. 1, No. 4, Summer, 1947, pp. 493–501.

Estimates of future volumes of transoceanic air transportation cannot be based on the past traffic of surface carriers. New and better modes of travel produce more travel, and rather than supplanting the steamship, each air line will stimulate its business. An historical survey of the growth of the American transportation system is given, with analogies to the future of air transport, and the role of the air carrier in the creation of "one world" is discussed.

What Does Commercial Aviation Need? J. H. Doolittle. *Shell News*, Vol. 15, No. 7, July, 1947. pp. 4–9, illus. An analysis of present trends and conditions in the air passenger transportation industry.

Scheduled Airlines of the United States. *Air Transportation*, Vol. 11, No. 1, July, 1947, p. 32, table.

A table listing 25 air lines and giving the areas of operation, the names of officials, the types of service rendered, and the types and numbers of aircraft in operation and on order.

Aerial Convention Between Spain and Argentina (Convenio Aéreo entre España y Argentina). *Mundo Aeronáutico* (Buenos Aires), Nos. 145, 146, May, June, 1947, pp. 27, 28; 22, 26. (In Spanish.) Text of the articles and annex of the aerial convention on civil air routes, signed in Madrid on March 1, 1947.

Aviation in Canada. R. A. C. Henry. *Air Affairs*, Vol. 1, No. 4, Summer, 1947, pp. 452–461. The potential significance of civil aviation on the social and economic life of Canada.

Aviation in India. Sir Frederick Tymms. *Air Affairs*, Vol. 1, No. 4, Summer, 1947, pp. 462–474.

An historical survey of the development of India's airways and a general survey of the air activities in India until the early part of 1947, with a summary of government policies and activities in the field.

Aviation in Africa. Derwent Whittlesey, Robert L. Williams, and Michael D. Dawson. *Air Affairs*, Vol. 1, No. 4, Summer, 1947, pp. 440–451, map. A history of the expansion of commercial air transport in Africa and a discussion of the continent as a field for future development.

Air Services in Britain; Railway Interests Passed to British European Airways. III—Development of Rival Airlines. *Modern Transport*, Vol. 57, No. 1479, August 7, 1947, p. 7, illus. (Cf. AER 5/47:33.)

Moscow Report Lifts Curtain on Soviet Civil Aviation Growth. Andrew Steiger. *Aviation Week*, Vol. 47, No. 10, September 8, 1947, pp. 55, 56, illus.

Miscellaneous statistics on the extent and growth of civil air transport. The 93,000 route-miles reported are said to be more than that of any other form of internal transport.

Línea Aeropostal Venezolana (LAV), Caracas, Venezuela. *U.S., Civil Aeronautics Board, Airline Manual, Supplement*, July 22, 1947. 28 pp., tables. 41 references.

Airplane Descriptions

Boeing Stratojet Bomber Heralds Transonic Combat. *Aviation Week*, Vol. 47, No. 12, September 22, 1947, pp. 14, 15, illus.

The Boeing XB-47 bomber is powered by six General Electric J-35 turbojet engines, which provide 24,000 lbs. of rated thrust. Four engines are paired in nacelles suspended below the wings near the fuselage, and two engines are located near the wing tips. Wing, fin, and stabilizer are swept back at an angle of approximately 45°. Range is estimated at 2,000 miles with a fuel load of 15,000 gal. of ANF28 gasoline or ANF34 kerosene.

AAF Unveils New XP-87 Fighter. *Aviation Week*, Vol. 47, No. 11, September 15, 1947, pp. 11, 12, illus.

The Curtiss-Wright XP-87 is a cantilever mid-wing fighter monoplane of 65-ft. wing span. It is powered by four Westinghouse 24C axial-flow turbojet engines which develop a total of 12,000 lbs. of static thrust. Ceiling is 40,000 ft. and maximum speed is 620 m.p.h. Range is 2,000 miles.

Spectral Development; The McDonnell XF2D-1 Banshee, Successor to the Phantom. *Flight*, Vol. 52, No. 2012, July 17, 1947, pp. 63, 64, illus.

Jet-Propelled Flying Boat Fighter (Saunders Roe SR/A1). *The Engineer*, Vol. 184, No. 4776, August 8, 1947, p. 124, illus. (Cf. AER 1/47:38.)

British Test New Jet Fighter; SARO Flying Boat Exhibits Speedy Take-Off Characteristics During Initial Flights in England. *Aviation Week*, Vol. 47, No. 8, August 25, 1947, p. 27, illus.

New in French Skies. *The Aeroplane*, Vol. 73, No. 1884, July 18, 1947, p. 74, illus.

The V.B. 10C-1 Arsenal is a two-engined, low-wing cantilever fighter-bomber monoplane. It is powered by two Hispano-Suiza 12Z 12-cylinder, upright, 60°-V, liquid-cooled engines in tandem. Maximum take-off power is 2,970 b.hp., maximum level

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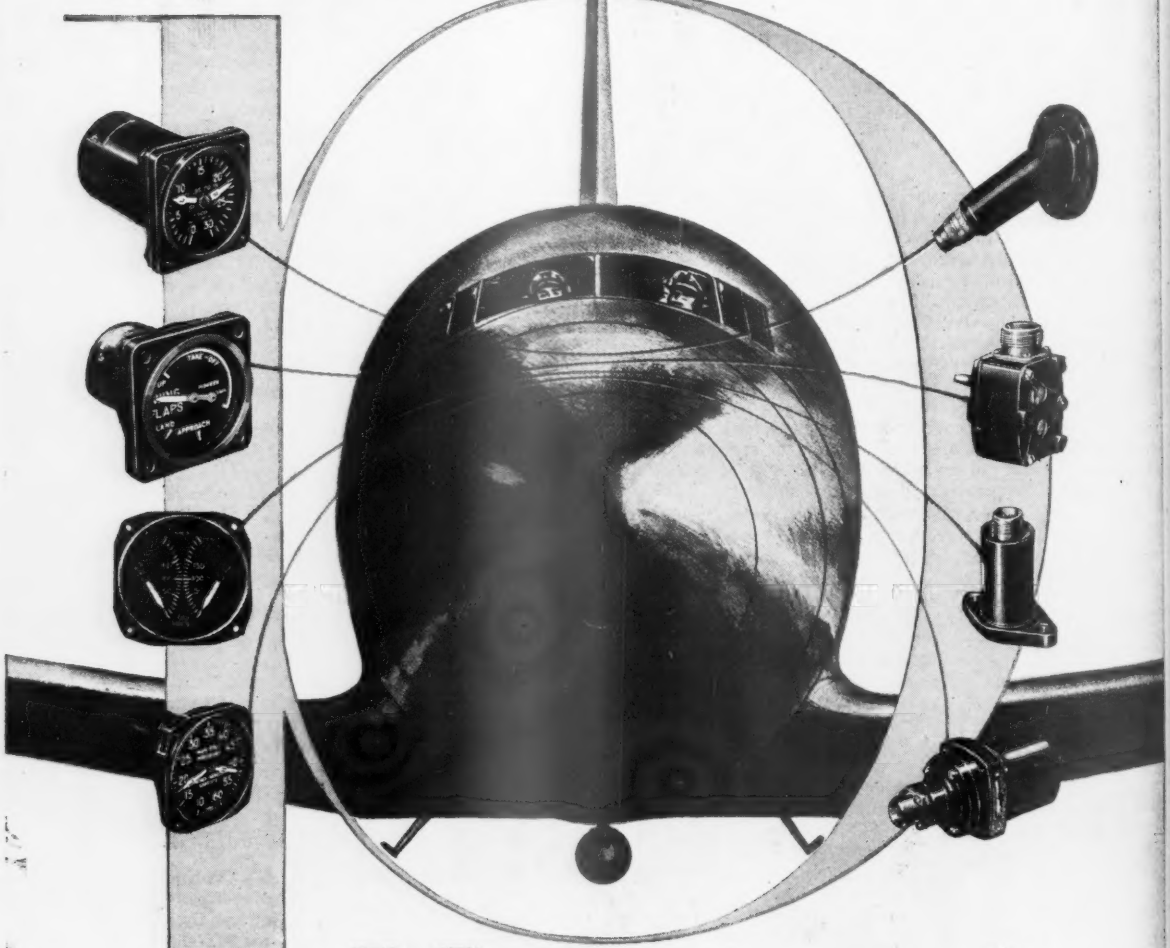

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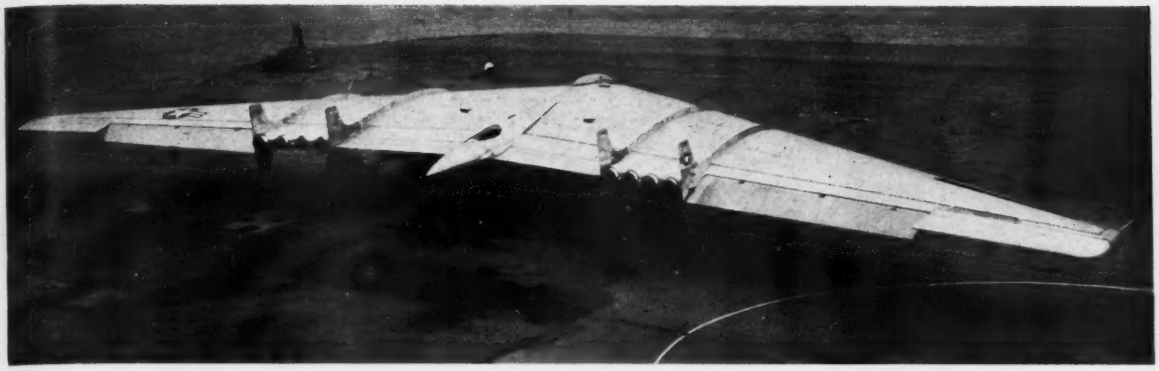


The Northrop YB-49, latest jet-propelled bomber of the U.S. Air Forces, powered by eight General Electric J-35 jet engines built by Allison.

speed is 435 m.p.h., and range with maximum fuel, 1,615 miles. The Norazur, type 2100, manufactured by the S.N.C.A. du Nord is a high-wing cantilever feeder-line transport monoplane. Two Potez 8D-03 pusher-type power plants produce a maximum of 840 b.hp. at sea level. Gross weight is 10,207 lbs.; pay load, 1,653 lbs.

The Aerocentre NC 1070. *The Aeroplane Spotter*, Vol. 8, No. 192, July 26, 1947, p. 160, illus.

A two-place mid-wing monoplane torpedo-dive-bomber, with a maximum speed of 359 m.p.h. at 22,637 ft. and a range of 2,112 miles. It is designed for carrier operation and has power-operated folding wings.

Bristol 167; Planning of the Interior; First Pressure Tests. *Flight*, Vol. 52, No. 2013, July 24, 1947, pp. 84a–84d, illus. (Cf. AER 11/46:29.)

Cunliffe-Owen "Concordia." *Shell Aviation News* (London), No. 109, July, 1947, pp. 20, 21, illus.

One of the French Flying-Boat Fleet (Latécoère 631 6-Engined 46-Passenger Flying Boat). *The Aeroplane*, Vol. 73, No. 1885, July 25, 1947, pp. 106–108, illus.

Visit of Latécoère 631: A Large French Flying Boat Designed for Transatlantic Service. *Modern Transport*, Vol. 57, No. 1478, July 26, 1947, p. 3, illus.

Massive Elegance; Six-Engined 70-Ton Latécoère 631 Demonstrates from Hythe. *Flight*, Vol. 52, No. 2013, July 24, 1947, pp. 87, 88, illus.

New Channel Wing Nears Flight. *Aviation Week*, Vol. 47, No. 11, September 15, 1947, pp. 21, 22, illus.

A second model of the channel-wing airplane invented by Willard R. Custer of Hagerstown, Md., is under construction. The channel-wing utilizes the lift created by air drawn horizontally over the airfoil by a propeller at the rear of the channel. The shape of the wing confines the air within a venturi so that flow depends only on the action of the propeller for its constancy and is not materially affected by wind changes and other variables. The lift is controlled by the pitch of the propeller and not by forward motion of the aircraft, thus enabling the craft to rise and descend almost vertically and to fly at reduced speeds. More efficient channels are to be used, which are expected to develop more than 75 per cent of the lift necessary for take-off before the aircraft has moved forward.

The Supermarine Seafire (Seafire F. Mk. 47 and F.R. Mk. 47.) *The Aeroplane*, Vol. 73, No. 1885, July 25, 1947, p. 104, illus.

Features of the Ambassador. *The Aeroplane*, Vol. 73, No. 1885, July 25, 1947, pp. 99–103, cutaway diagrs.

Airspeed Ambassador: Further Details of the A.S. 57: Unique Control Transmission. *Flight*, Vol. 51, No. 2013, July 24, 1947, pp. 75–78, cutaway diagrs.

The Portsmouth Aviation Aerocar Major. *The Aeroplane Spotter*, Vol. 8, No. 191, July 12, 1947, p. 153, illus.

The Third Brussels International Air Show 1947. *The Aeroplane Spotter*, Vol. 8, No. 192, July 26, 1947, pp. 161–163, illus.

Italians Diversify New Plane Types. *Aviation Week*, Vol. 47, No. 4, July 28, 1947, p. 32, illus.

Low-Cost Single-Seater. George E. Haddaway. *Southern Flight*, Vol. 28, No. 1, July, 1947, pp. 10–12, 36, illus.

The Mooney Model M-18, which has a gross weight of 700 lbs., employs a four-cylinder Crosley engine developing 25 hp. The fuselage length is 18 ft. and the wing span is 27 ft. Range is 400 miles; cruising speed, 90 m.p.h.

Mooney M-18 Prototype Has Fast Climb. *Aviation Week*, Vol. 47, No. 4, July 28, 1947, p. 13, illus.

The Westland Wyvern T.F. Mk.I. *The Aeroplane*, Vol. 73, No. 1885, July 25, 1947, p. 104, illus.

A New Ultra-Light Aircraft. *The Aeroplane*, Vol. 73, No. 1884, July 18, 1947, p. 66, illus.

The Tipsy Junior, manufactured by Avions Tipsy, Belgium, is a wooden-construction single-seater trainer with an open cockpit. Wing span is 22.6 ft. and gross weight 594 lbs. It is powered by an engine of between 25 and 65 b.hp.

Belgium Offers New Tipsy Junior. *Aviation Week*, Vol. 47, No. 8, August 25, 1947, p. 29, illus.

Japanese Emily 22 a Made-in-Japan Product. *Naval Aviation News* (*Naval Air Reserve Edition*), No. 4, August, 1947, p. 24, illus.

The Kawanishi Emily 22 flying boat is a patrol reconnaissance aircraft powered by Kasei 22 engines. The normal rating of 1,825 hp. of each engine can be increased to 1,880 hp. by water injection.

The Miles M.38 Messenger IIA. *The Aeroplane Spotter*, Vol. 8, No. 192, July 26, 1947, p. 165, illus.

Miles Building 20-Passenger Liner, the Merchantman. *Aviation Week*, Vol. 47, No. 8, August 25, 1947, p. 28, illus. (Cf. AER 7/47:39.)

Mile's New M.68 Has Roadable Cargo-Hold. *Aviation Week*, Vol. 47, No. 13, September 29, 1947, p. 22, illus.

Airplane Design

Stalling Phenomena and the Tailless Aeroplane. V, VI. A. R. Weyl. *The Aeroplane*, Vol. 73, Nos. 1883, 1886, July 11, August 1, 1947; pp. 47–49; 133–135; illus., diagrs. (Cf. AER 10/47:37.)

V. The chief factors that determine the characteristics of the pitching-moment curve at stall are the sweepback and the aspect ratio of the wing. While in the case of moderate sweepback the introduction of wing twist and an increase in section chamber toward the tip will tend to prevent premature tip stall, the use of suction slots for this purpose seems preferable. **VI.** After a résumé of their development, leading-edge flaps are evaluated and compared with automatic wing-tip slots. Control of the boundary layer by suction as a remedy for tip stall is examined from an appraisal of data on existing designs. A combination of suction and discharge may be the most effective remedy.

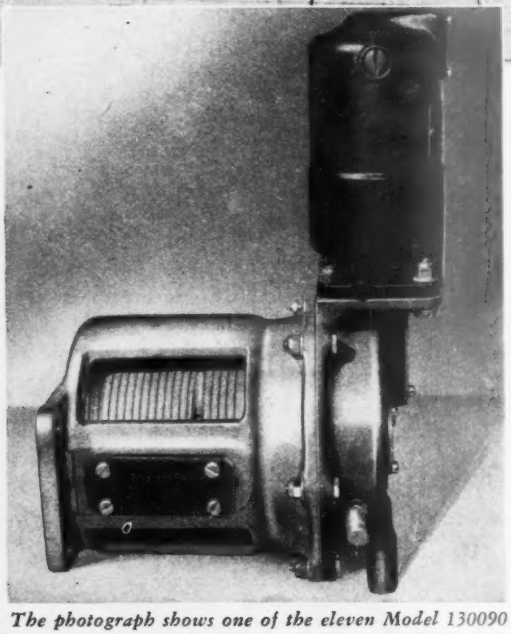
Stall-Resistant Craft Seen Through New Design Data; Principles Outlined for Stall-Proofing Lightplanes: NACA Studying Two-Control System Possibilities. *Aviation Week*, Vol. 47, No. 11, September 15, 1947, p. 24.

A summary of data obtained from recent research on restricted and linked control surfaces, specialized wing design, and auxiliary lift devices, and their effectiveness in stall prevention.

Escape Method Developed for Douglas D-558 Skystreak. R. C. Donovan. *Aviation Week*, Vol. 47, No. 10, September 8, 1947, pp. 34, 37, illus.

No Problem "*TOO BIG*" for Pacific-Western

The B-36, world's largest land based bomber. It has a range of 10,000 miles, is powered by six motors and has bomb bay space equal to the volume of four freight cars.



The photograph shows one of the eleven Model 130090 actuators which, with variations in drum length, depending on job requirement, are incorporated in the B-36.

ELEVEN SPECIALLY DESIGNED PACIFIC-WESTERN ACTUATORS operate the bomb bay and turret doors of this giant plane. These PACIFIC-WESTERN actuators incorporate a compact, efficient, three-step gear reduction providing a total ratio of 585:1. The actuator, consisting of motor, gear reduction and cable drum, weighs only 13 pounds but delivers 3600 inch pounds output torque.

Again, PACIFIC-WESTERN is proud to have participated in helping plane designers to make aviation history. Over a half a century of gearmaking experience is available to help you solve your problems in aviation gearing.

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GEAR PRODUCTS

The nose section can be unhooked mechanically from the main body of the fuselage by the pilot. After the nose section has decelerated sufficiently, the pilot operates a control that withdraws the backrest and shoulder-harness coupling pins and permits him to fall free and open his parachute.

Luscombe Re-Design Cuts Costs. Alexander McSurely. *Aviation Week*, Vol. 47, No. 9, September 1, 1947, pp. 22–24, illus.

Ten Years of Jet Propulsion. Louis Bruchiss. *Air Trails*, Vol. 28, No. 6, September, 1947, pp. 42–45, 78, illus.

A Method of Calculating the Heat Required for the Prevention of Fog Formations on the Inside Surfaces of Single-Panel Bullet-Resisting Windshields During Diving Flight. James Selna and John E. Zerbe. *U.S., N.A.C.A., Technical Note No. 1301*, July, 1947, 33 pp., figs. 4 references.

Airports

1947-8 Federal Airport Program (Public Law 377, 79th Congress, Chapter 25, 2nd Session. *U.S., Civil Aeronautics Administration, Office of Airports*, August 4, 1947. 155 pp., tables.

Location of Underground Cable Failures. M. S. Gilbert. *U.S., Civil Aeronautics Administration, Technical Development Note No. 41*, June, 1946. 5 pp., illus.

A Laboratory Study of the Soil Stabilizing Effectiveness of Artificial Resins with Special Emphasis on the Aniline-Furfural Resins. Hans F. Winterkorn. *U.S., Civil Aeronautics Administration, Technical Development Note No. 43*, 1947. 45 pp., figs.

Business and Finance

Review of American Aircraft Finance. Francis A. Callery. *Air Affairs*, Vol. 1, No. 4, Summer, 1947, pp. 484–492.

An historical survey of financial methods in the aircraft manufacturing industry, with particular reference to the growth of working capital and the financing of wartime expansion. Six large companies are taken as an index to the industry, and charts are given of their average working capital, percentage distribution of total current assets and liabilities, and percentage of inventories and receivables financed by the government for 1941, 1943, 1944, and 1945.

Control Systems

Flight Investigation on a Fighter-Type Airplane of Factors Which Affect the Loads and Load Distributions on the Vertical Tail Surfaces During Rudder Kicks and Fishtails. John Boshar. *U.S., N.A.C.A., Technical Note No. 1394*, August, 1947. 89 pp., illus. 8 references.

There were two significant loads for rudder kicks, deflection load and dynamic load. The deflection load was produced as a result of an abrupt control deflection. The dynamic load comprised a load corresponding to the new static equilibrium condition for the deflected rudder and a load caused by a transient overshoot. The deflection load was proportional to the angular acceleration which, in turn was dependent upon the rate and amount of control deflection and upon the directional response characteristics of the airplane. The reversal of the rudder at the time of maximum sideslip superimposed an angular acceleration load on the dynamic load. The critical loads on the rudder were associated with the deflection loads, and those on the fin were associated with dynamic loads. In fishtail maneuvers, it was found that the pilot tended to deflect the rudder in phase with the natural frequency of the airplane. At the condition of resonance, the load on the fin and the load on the rudder were approximately 90° out of phase. The maximum loads measured in fishtails were in the same order of magnitude as those from rudder kicks in which the rudder was returned to zero at the time of maximum sideslip.

Wind-Tunnel Investigation of the Effect of Tab Balance on Tab and Control-Surface Characteristics. Jack D. Brewer and M. J. Queijo. *U.S., N.A.C.A., Technical Note No. 1403*, August, 1947. 79 pp., illus. 11 references.

Results indicated that, in general, tab balance affected tab hinge-moment characteristics in much the same manner that flap balance affects flap hinge-moment characteristics. A moderate amount of tab balance did not seem to have adverse effect on flap hinge-moment characteristics. Transition strips placed near the leading edge of an airfoil reduced the effectiveness of both plain and balanced tabs. Opening the tab gap reduced the tab effectiveness, but the reduction became less as the tab balance was increased. Application (by an approximate method) of the results to two typical airplanes indicated that the addition of overhang balance to spring tabs was an effective means of reducing the control forces of spring-tab ailerons. Tabs with sealed internal balances were generally less effective in reducing aileron control forces than tabs with round-nose overhangs of the same balance length.

Hinge-Moment Characteristics of Balanced Elevator and Rudder for a Specific Tail Configuration on a Fuselage in Spinning Attitudes. Ralph W. Stone, Jr., and Sanger M. Burk, Jr. *U.S., N.A.C.A., Technical Note No. 1400*, August, 1947. 24 pp., diagrs. 3 references.

Results of investigations in the Langley 15-ft. free-spinning tunnel. The elevator hinge-moment coefficients varied normally with angles of attack, yaw, and deflection. The elevators had a strong upfloating tendency and push forces were required to deflect the elevators. The elevator balance was effective in counteracting the pull force required to hold the elevator up in spinning attitudes but did not affect the force required to push the elevator to neutral. Trim tabs were effective in reducing hinge moments required to move the elevator to neutral or down. The shielding effect of the horizontal tail and fuselage on the rudder increased with angle of attack, as indicated by the reduction in rudder hinge moments. The rudder balance appeared to be effective in reducing the rudder pedal forces. The rudder became overbalanced at angles of attack greater than approximately 40°.

Wind-Tunnel Investigation of Unshielded Horn Balances on a Horizontal Tail Surface. John G. Lowry and Stewart M. Crandall. *U.S., N.A.C.A., Technical Note No. 1377*, July, 1947. 36 pp., illus. 4 references.

Tests results indicated that the increments for the variation of hinge-moment coefficient with angle of attack and elevator deflection caused by change in the size of the unshielded horn are approximately linear functions of the ratio of the horn area moment to the elevator area moment. The control-force characteristics, as estimated from the data and as obtained from flight tests, were in good agreement when the surface irregularities of the airplane were simulated on the model.

Two-Dimensional Wind-Tunnel Investigation of Spoiler Aileron Flap Model for the Hughes XF-11 Airplane. William J. Underwood and Felicien F. Fullmer, Jr. *U.S., N.A.C.A., Memorandum Report No. L5C29* (*Wartime Report No. L-644*), April, 1945. 42 pp., illus. 2 references.

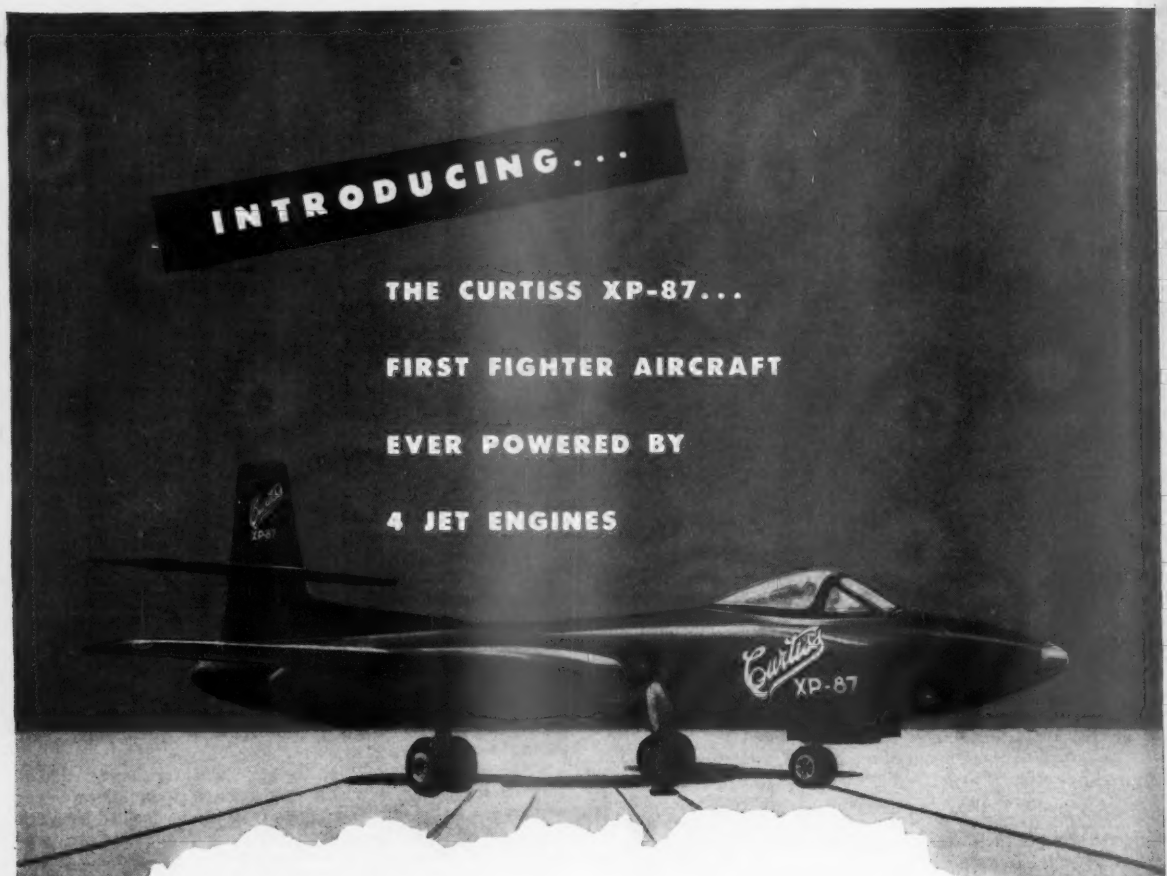
Flight Measurements of the Rudder Control and Sideslip Characteristics of Four Vertical Tail Arrangements on the P-40 Series Airplanes. Harold I. Johnson and Joseph R. Vensel. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. L-547*), October, 1942. 37 pp., illus.

Flight Measurements of the Effect on Elevator Stick Forces of Stabilizer Incidence and Elevator Rib Spacing on the P-63A-1-BE Series Airplane. Harold I. Johnson and Robert G. Mungall. *U.S., N.A.C.A., Memorandum Report No. L5J09* (*Wartime Report No. L-611*), October, 1945. 26 pp., illus. 2 references.

Engine Parts and Accessories

New Method of Computing Effective Valve Area. Edward G. Ingram. *Automotive Industries*, Vol. 97, No. 3, August 1, 1947, pp. 34, 35, 68, 86, diagrs.

The conventional formula used for determining the effective area of poppet valves fails when the valve is lifted beyond a certain point. Two formulas are derived: one for finding the last point in the lift for which the conventional formula applies, and the other for finding the effective area in the usual case where the lift is above this last point. The width of valve face affects the point where the conventional formula fails. The usual method used to determine the increase in the effective area of a valve obtained by decreasing the seat angle is based on unsound assumptions. Effective valve area comparisons for valves with different seat angles, based on the writer's method, are presented. No definite statement can be made regarding the percentage of increase in valve area realized with a given decrease in seat angle because this will depend on the particular valve dimensions.



▸ **Curtiss-Wright**—producer of many famous fighter airplanes, starting with the very first pursuit ship (P-1) and including the famed P-36 and P-40 Hawk series—pioneers again with the Curtiss XP-87, the first four engine jet-propelled fighter airplane for the U. S. Air Force.

▸ **One of the largest** fighter aircraft of its type built by any nation, with a wing span of approximately 60 feet and overall length of about 65 feet, the XP-87 is operated by a two-man crew and powered by four Westinghouse jet engines.

▸ **The Curtiss XP-87** is specifically equipped for operating under extreme weather conditions . . . it embodies the most recent advances in anti-icing equipment.

▸ **The new airplane** is now undergoing ground and taxi tests. At their completion, it will be taken to the Muroc Army Air Base, Muroc Lake, California for flight testing.

CURTISS WRIGHT

Vector Analysis of Epicyclic Gear Trains. Leo Avondoglio. *Product Engineering*, Vol. 18, No. 8, August, 1947, pp. 171, 173, diagrs.

Compound epicyclic gear trains can be solved by velocity vectors using a graphic method. The diagram can be drawn by considering the gear elements that are in mesh as made up of levers. If the points on the levers are assumed to remain at a constant vertical distance from the instantaneous centers and the levers are allowed to stretch while moving through a small angular displacement, the points will assume a position that gives a picture analogous to the vector diagram.

The Vernisse Coupling for Tandem Engines; A Brief Note on the Ingenious Constant-Torque Joint Developed by the Arsenal de l'Aéronautique. *Aircraft Engineering*, Vol. 19, No. 221, July, 1947, p. 217, illus.

The Vernisse coupling is a constant-torque joint which may be used to couple coaxial propellers to the drive shafts of buried tandem engines. The effect of the deformation of the aircraft structure and the bending and twisting of the shafts is accommodated by the linkage of a driven plate, coupling sleeves, and the driving plate. In the driving plate there are spherical housings which contain spherical self-aligning bearings. The bearings slide over the coupling sleeves. The sleeves are joined to the driven plate by spherical jointed pins that are mounted in the driven plate and slide inside the sleeves.

Modern Cowl Design Saves Operators Time and Expense. *Aviation Week*, Vol. 47, No. 13, September 29, 1947, pp. 18, 19, illus.

Each engine cowl of the Convair-Liner consists of four panels that are hinged at the firewall and can be swung out independently to give complete accessibility to the engine. Ducting is built into the panels and is out of the field of work of the mechanic when the panels are open. The segments of the cowl are fastened by trunk-type locks and shear pins which align each panel with the next.

Elimination of Rumble from the Cooling Ducts of a Single-Engine Pursuit Airplane. Howard F. Matthews. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. A-70)*, August, 1943. 29 pp., illus.

Superchargers for Small Aircraft Engines. W. O. Meckley. *Western Flying*, Vol. 27, No. 8, August, 1947, pp. 16, 32, diagrs.

A Comparative Study of Weights and Sizes of Flat-Plate Exhaust-Gas-to-Air Heat Exchangers With and Without Fins. Thorval Tendeland and Charles P. Steinmetz. *U.S., N.A.C.A., Technical Note No. 1312*, July, 1947. 53 pp., illus. 9 references.

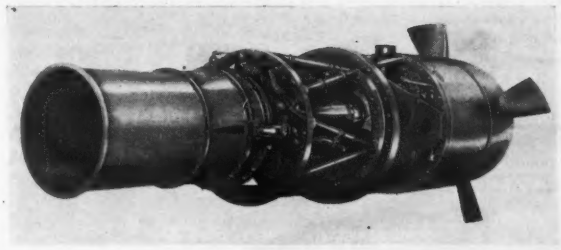
A study of the overall size and weight reduction of flat-plate type of heat exchangers by the addition of fins to the surfaces. Two representative heat exchangers were constructed and tested to verify the results of a theoretical analysis. A considerable reduction in overall size or volume results when fins are used in both the air and the exhaust-gas passages. The largest reductions in volume occur with the use of fins with high efficiencies. The reduction in weight with the use of fins in both the air and the exhaust-gas passages depends upon the design efficiency of the fins and the dimensions of the fluid passages gaps. The largest reductions in weight were obtained with the lowest design fin efficiencies (70 per cent) and in exchangers that have a large number of passages with the same size air and exhaust-gas passage gaps.

Engines, Gas Turbine

Determination of Turbojet Engine Thrust from Tailpipe Measurements. Raymond W. Pyle. *Journal of the Aeronautical Sciences*, Vol. 14, No. 9, October, 1947, pp. 561–564, figs. (*See* AER 5/47:26.)

Centrifugal Impellers; Practical Considerations in Their Design for Applications Such as Superchargers and Gas Turbines. Harold Woodhouse. *Machine Design*, Vol. 19, No. 8, August, 1947, pp. 121–126, diagrs.

The different centrifugal impellers commonly used for the various tip speeds of the gas-turbine compressor impeller are surveyed. The modifications in methods of fabrication, design of the inducer and discharge sections, and the control of the vane thickness and contour which have been required by the increased tip speeds are illustrated.



Napier "Naiad," latest English development of the combination propeller-turbine engine.

Boeing Develops Baby Turbojet. *Aviation Week*, Vol. 47, No. 4, July 28, 1947, p. 31, illus.

Model 502, a two-burner turboprop engine, weighs 140 lbs. and delivers 200 shaft hp. and 50 lbs. of exhaust thrust. Model 500, a two-burner turbojet, develops 150 lbs. of static thrust and weighs only 85 lbs.

Development of the Trent. *The Aeroplane*, Vol. 73, No. 1885, July 25, 1947, p. 92, illus. The Trent is a modification of the Rolls-Royce Series II Derwent, with reduction gear added for a propeller drive.

Rolls-Royce "Trent" Gas Turbine Propeller Engine. *The Engineer*, Vol. 184, No. 4774, July 25, 1947, p. 88, illus.

"Know-How" from the Trent; Rolls-Royce Airscrew Turbine Development; Flight-Testing the Trent-Meteor. *Flight*, Vol. 51, No. 2013, July 24, 1947, pp. 79, 82, illus.

Design Changes in J-33 Turbojet. John Foster, Jr. *Aviation Week*, Vol. 47, No. 7, August 18, 1947, pp. 21, 22, illus.

The redesign of individual components and changes in production technique made by the Allison Division of General Motors Corp. since taking over the development of the J-33 turbojet have resulted in a 40 per cent increase in thrust. A reduction in weight of 7 per cent was accomplished with an increase of 300 per cent in the life of the engine.

The Development of the Goblin Engine. E. S. Moult. *De Havilland Gazette*, No. 39, June, 1947, pp. 4–10, illus.

A detailed description of the Goblin 2. The steps in the development of the single-entry centrifugal compressor, the turbine, and the combustion chambers are described. Test methods and instruments used with the various components of the engine are discussed.

Development of the Jet-Propulsion Gas Turbine for Aircraft. Frank Whittle. *The Engineering Journal*, Vol. 30, No. 7, July, 1947, pp. 316–322, illus. Discussion, pp. 323–325.

A general outline of the theory of the jet propulsion and the design of the individual engine components. A comparison is made with the piston-propeller engine. The advantages of the centrifugal compressor over the axial-flow compressor and the importance of the mechanics of combustion and fuel mixing are emphasized.

Turbojet "Yardsticks" Checked in Flying Lab Tests. W. O. Meckley. *Aviation Week*, Vol. 47, No. 7, August 18, 1947, pp. 26, 29, diagrs.

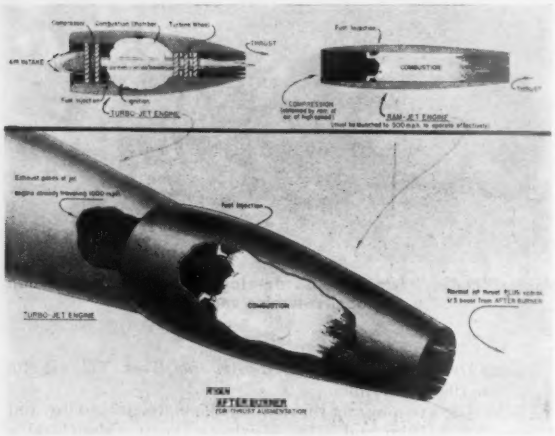
Bench trials of turbojets include tests to determine the drag of windmilling of the engine, the thrust potential, and the burner blowout temperature. Test methods and instruments are described and evaluated.

Mounting Jet Engines. J. C. Buechel. *Aviation Week*, Vol. 47, No. 5, August 4, 1947, pp. 24, 27, illus.

The mounting of the General Electric J-35 (TG-180) is used as an illustration to show the basic design considerations for proper installment. The trunion pads, the ball and socket, and the sliding trunions which are used in its three-point mounting are described.

Performance and Ranges of Application of Various Types of Aircraft Propulsion Systems. *U.S., N.A.C.A., Technical Note No. 1349*, August, 1947. 137 pp., diagrs. 2 references. (Cf. AER 5/47:22.)

This group of papers on the comparison of the performance of six aircraft-propulsion systems was prepared by members of the N.A.C.A. Flight Propulsion Research Laboratory staff under the direction of Benjamin Pinkel and was presented at the meeting of the Institute of the Aeronautical Sciences on Aircraft Propulsion Systems held in Cleveland, Ohio, on March 28, 1947.



The After Burner, developed by Ryan Aeronautical Company for the Navy, is said to boost the thrust of jet engines by as much as one-third. (The part of the photograph showing the After Burner was inadvertently omitted from the illustration published on page 43 of the August Review.)

Design and Operation of Some Experimental High-Temperature Gas-Turbine Units. A. D. Hughes. *American Society of Mechanical Engineers, Transactions*, Vol. 59, No. 6, August, 1947, pp. 549–558. Discussion, pp. 558, 559, illus.

A detailed description of the instrumentation and test procedures used in the testing of a series of stationary gas-turbine designs. Tests were conducted under full-scale conditions in order to evaluate the service life of material and the design of components used in turbine construction. Tests have been carried out at increasingly higher temperatures since 1944, and a series of runs has been completed at 1,550°F.

Engines, Reciprocating

Supercharging and Internal Cooling Cycle for High Output. R. H. Miller. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 5, July, 1947, pp. 453–457, figs. Discussion, pp. 457–464.

The reduction of the temperature of a charge before compression in either a Diesel or Otto-cycle engine is a more effective means of increasing the output than increasing the pressure. The gains that may be made by supercharging with and without intercooling the charge in the inlet manifold are shown by example and diagram. The dual-pressure supercharging cycle and high-pressure supercharging with high combustion pressures are examined. It is shown that by selection of blower-discharge pressure and proper timing of the inlet-valve closing, engines equipped with the dual-pressure supercharging system will carry full sea-level rating at all altitudes.

Progress in the Air-Cooling of Sleeve-Valve Aero-Engines. D. J. Kenney. *Shell Aviation News* (London), No. 109, July, 1947, pp. 16–19, illus.

An analysis of the internal and external cooling drag of the power plant. The use of wedge-section piston rings, oils with antigumming additives, and ceramic extensions on the spark plugs have made possible higher engine operating temperatures. An increase in the cylinder-head fin area, improved design of barrel-fin pitch, improved internal ducting and the design of the rear exhaust system to eliminate the preheating of the cooling air has reduced the cooling drag of each nacelle to 7.2 lbs., which represents only 5 per cent of the total aircraft drag.

Evaluating Russian Aircraft Engines. Paul H. Wilkinson. *Aviation Week*, Vol. 47, No. 4, July 28, 1947, pp. 24, 26, 27, illus.

A description of seven reciprocating aircraft engines being produced in the U.S.S.R. Their specifications are given and their development is traced back to the American, British, and French originals from which they are derived.

Instantaneous Ultraviolet Knock Spectra Correlated with High-Speed Photographs. M. A. Hirshfeld and Cearcy D. Miller. *U.S., N.A.C.A., Technical Note No .1408*, August, 1947. 22 pp., illus. 14 references.

To determine whether a comparison, before and after knock, of the absorption spectra of combustion gases in an operating engine cylinder could give evidence of a chemical reaction concurrent with knock. A satisfactory exposure of an absorption spectrum was obtained in an interval of approximately 7 microsec. during one firing cycle. A high-speed schlieren motion picture of the same cycle was taken in order to establish accurately the time at which the spectrogram was exposed with reference to the knock. The results showed the method to be practicable. In this experiment the spectrogram, which was taken in the near ultraviolet, showed no chemical change taking place at the instant of knock and did not show the presence of any molecular species in the burning charge before knock which might contribute to the cause of knock.

Photography in Engine Research: Practical Application of Still and Ciné Photography. I—Oil-Film Investigation, Photomicrography, Process Illustration, Fuel-Spray Examination by Flash. H. D. Goulding. *Aircraft Production*, Vol. 9, No. 106, August, 1947, pp. 283–287, illus.

Rolls-Royce "Eagle." *Shell Aviation News* (London), No. 109, July, 1947, pp. 22, 23, illus. (Cf. AER 7/47:47.)

Engines, Rocket

New Methods Developed for Evaluating Rocket Motors. *Aviation Week*, Vol. 47, No. 13, September 29, 1947, pp. 20, 21, illus.

A survey of the production tests used for solid and liquid propellent charges and of the methods used to calibrate standard jet-assisted take-off units. The large number of factors that must be recorded simultaneously when testing liquid rocket fuels has led to the use of multiple-element continuous-recording galvanometer-type oscillographs. Higher output pickups and a discriminator that eliminates the need for amplification are expected to raise the accuracy of these instruments to plus or minus 1 per cent.

Letter to the Editor. M. Z. Krzywoblocki and R. W. McCloy. *Journal of the Aeronautical Sciences*, Vol. 14, No. 9, October, 1947, pp. 564–566, 582.

Formulas are developed to show that the expression used by the authors for propulsion efficiency, based on kinetic energy, agrees with conventional expressions based on momentum. The coefficient of propulsion efficiency differs for each type of reaction-propulsion unit and can never equal 100 per cent. A table is presented which gives a summary of the instantaneous propulsive efficiencies of various systems of propulsion by reaction.

Hydrogen Peroxide for Power Plants. C. G. Grewson and N. S. Davis, Jr. *Mechanical Engineering*, Vol. 69, No. 8, August, 1947, pp. 682–684, figs. (Cf. AER 2/47:49.)

Comments on the paper "Hydrogen Peroxide for Propulsive Power—Production and Use by the Germans During World War II" by Logan McKee (*Mechanical Engineering*, December, 1946). American industry produced 90 per cent concentrations of hydrogen peroxide of greater purity than the 85 per cent product manufactured in Germany. Instability in storage was found to depend primarily on contamination. It was not found necessary to wax-line the storage containers if they were made of pure aluminum or of certain stainless steels. Fires caused by spillage could be controlled by flushing with water. Polyvinylchloride rubber gave adequate protection from contact with the agent. An enthalpy chart shows the pressure, temperature, and physical conditions of the products of decomposition of various concentrations of hydrogen peroxide.

Lightplane JATO Seen in Rocket Design. *Aviation Week*, Vol. 47, No. 12, September 22, 1947, pp. 21, 22, diagrs.

An outline of the development of jet-assisted take-off units and their components. A unit is being designed which will weigh 50 lbs. and provide 250 lbs. thrust for 17 sec.

Fire Prevention

The Prevention of Fire in Aircraft. W. G. Glendinning and J. W. Drinkwater. *Royal Aeronautical Society, Journal*, Vol. 51, No. 439, July, 1947, pp. 616–641, illus. Discussion, pp. 641–650.

An extensive treatment of the causes and the prevention of fires in aircraft. Statistics and full-scale tests indicate that the causes of fires during flight, on the ground, and in crashes can be minimized by proper design. Combustibles should be separated from the sources of ignition. Tanks and fuel systems should be

resistant to the effects of heavy landings. Detail diagrams are given of the test setups used in full-scale engine fire-extinguishing tests.

Flight Technique

Analyzing Winds for North Atlantic Flight. F. M. Booth. *Air Transport*, Vol. 5, No. 8, August, 1947, pp. 36–38, 76, figs.

An actual operation over the North Atlantic route is used to illustrate a method of wind analysis which can be applied to the performance of any airplane. A number of wind curves have been prepared which are based on the records of the British Overseas Airways Corporation and from which the relative performance of different aircraft can be determined.

Flight Testing and Performance

Range Performance of Turbojet Airplanes. Irving L. Ashkenas. *Northrop Aircraft, Inc.* (For abstract see "I.A.S. Briefs" on page 18 of this issue, November, 1947.)

Wind-Tunnel Investigation of the Effect of Power and Flaps on the Static Lateral Stability and Control Characteristics of a Single-Engine High-Wing Airplane Model. John R. Hagerman. *U.S., N.A.C.A., Technical Note No. 1379*, July. 74 pp., diagrs. 9 references.

The application of power with the flap neutral was found to make no appreciable change in the effective dihedral. Directional stability at low lift coefficients was increased, and rudder effectiveness was reduced. Deflection of the single full-span slotted flap decreased effective dihedral and increased directional stability and rudder effectiveness. Deflection of the full-span double-slotted flap with power on decreased effective dihedral and rudder effectiveness and increased directional stability. The addition of tail surfaces increased effective dihedral and directional stability. The high-wing model was found to have greater effective dihedral and greater rudder effectiveness than the low-wing model. Fin effectiveness on the high-wing model was smaller.

Correlation of Experimental and Calculated Effects of Product of Inertia on Lateral Stability. Marion O. McKinney, Jr., and Hubert M. Drake. *U.S., N.A.C.A., Technical Note No. 1370*, July, 1947. 18 pp., diagrs. 10 references.

The results obtained from free-flight tests on an airplane model having a 42°-sweptback wing were in good agreement with the calculated lateral-stability boundaries when the product of inertia terms was included in the calculations. Neglecting the product of inertia led to wide discrepancies between calculated and measured stability. The general flying characteristics were influenced primarily by the static directional stability and secondarily by the stability of the lateral oscillations. A certain minimum of static directional stability was required for good controllability even when less directional stability provided good damping of the lateral oscillations.

The Effect of Modifications to the Horizontal-Tail Profile on the High-Speed Longitudinal Control of a Pursuit Airplane. Charles F. Hall. *U.S., N.A.C.A., Technical Note No. 1302*, August, 1947, 69 pp., illus. 2 references.

Two symmetrical stabilizers, two flat-sided elevators, and three elevators with bulged profiles were investigated. The tests covered Mach Numbers from approximately 0.30 to 0.80. The data indicate that the modifications to the horizontal-tail profile had almost no effect on the pitching-moment characteristics of the model, but had a powerful effect on the hinge-moment characteristics. Bulging the elevator profile eliminated or reduced the severity of the reversal of stick force at high speeds and reduced the stick-force gradient. The control characteristics were thereby improved.

The Distributed Longitudinal Motion of an Uncontrolled Aircraft and of an Aircraft with Automatic Control. S. Neumark. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2078*, January, 1943. 53 pp., figs. 10 references. British Information Services, New York. $3.00.

Complete solutions have been worked out for the general case of uncontrolled flight and flight with automatic control, following an arbitrary initial infringement in equilibrium conditions. Several types of complete numerical solutions have been computed for attitude and manometric control. The good qualities of the attitude control are contrasted with the failure of the manometric control in certain types of gust when fitted to an aircraft such as the Wellington II. Large phugoid damping, though causing all disturbances to die out rapidly, does not by itself ensure a satisfactory behavior with automatic control A clearly marked difference was found in the course of the disturbance in pitch following an initial change in air speed. The initial swing in pitch is much smaller with an attitude control than in uncontrolled flight and is particularly marked with a neutrally stable aircraft. With a manometric control, the initial swing is nearly as large as in uncontrolled flight, especially for the larger control valves, and seems to be an inherent defect.

A Comparison of Flight-Test Results on a Scout-Bomber Airplane with a 4.7° and with a 10° Geometric Dihedral in the Wing Outer Panels. Charles M. Forsyth and William E. Gray, Jr. *U.S., N.A.C.A., Technical Note No. 1407*, August, 1947. 28 pp., illus. 4 references.

No unusual or undesirable lateral control characteristics were observed with the combinations of directional and lateral stability parameters which were obtained with the two dihedral angles used. The use of as much as 10° geometric dihedral in the wing outer panel did not lead to unsatisfactory lateral control characteristics of the airplane. The only limitation displayed by the airplane with 10° dihedral was in rudder-fixed aileron rolls at low speeds and small aileron deflections when the rolling velocity approached zero. A slight increase in geometric dihedral above the 10° used in the tests might cause a reversal of rolling velocity in rudder-fixed aileron rolls. The control-free lateral oscillatory characteristics of the airplane with 10° geometric dihedral were not a factor in placing an upper limit on the wing dihedral for the airplane as tested, even with its rather low directional stability at small sideslip angles.

Testing Civil Aircraft. P. A. Hufton. *Royal Aeronautical Society, Journal*, Vol. 51, No. 439, July 1947, pp. 575–602, diagrs. Discussion, pp. 602–615. 4 references.

The tests made on civil aircraft by the Aircraft and Armament Experimental Establishment, Boscombe Downs, England, not only certify compliance with the airworthiness requirements of the Air Registration Board but provide the manufacturer with data for perfecting prototypes. Take-off requirements, longitudinal stability, and the stall tests are described in detail to show how the conditions that they aim to establish provide for a reasonable margin of safety. The requirements laid down by PICAO for airworthiness are discussed in the light of British experience. The extension of tests and test methods which will be required to accommodate for the turbine engine and to take into account the effect of compressibility are specified.

The Neutral Point and Static Stability. R. G. Naugle. *Western Flying*, Vol. 27, No. 8, August, 1947, pp. 12, 13, 30, diagrs.

The static margin, the distance between the center of gravity and the aerodynamic center of an airplane, is a measure by which the stability of an aircraft can be predicted. The stick position and the stick force, both of which can be measured directly, bear a direct relation to the aerodynamic center in any condition of flight. These measurements taken during flight tests would provide adequate stability data.

Effects of Airplane Design Efficiency and Engine Economy on Range. Maurice J. Brevoort, George W. Stickle, and Paul R. Hill. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. L-671*), December, 1942. 56 pp., figs. 4 references.

The Flight Envelope. William Morse. *Aeronautics*, Vol. 17, No. 1, August, 1947, pp. 42–44, figs.

The flight envelope is essentially a graph that shows the maximum acceleration along an axis perpendicular to the path of flight in relation to the forward speed of the aircraft. An envelope is drawn for a hypothetical aircraft to show its development from plots of the normal acceleration against one-half the velocity squared.

Flight Measurements of the Lateral Control Characteristics of an Airplane Equipped with a Combination Aileron-Spoiler Control System. Lawrence A. Clousing and William H. McAvoy. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. A-68*), September, 1942. 55 pp., illus. 1 reference.

Investigation of the Longitudinal Stability at High Speeds of a 1/8-Scale Model of a Tailless Pursuit Airplane. Edmund V. Laitone. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. A-77*), March, 1943. 22 pp., illus.

Measurement of Flying Qualities of a de Havilland Mosquito F-8 Airplane (AAF No. 43-334960). II—Longitudinal Stability and Control Characteristics. H. L. Crane, D. H. Talmage, and

W. E. Gray, Jr. *U.S., Memorandum Report No. L5G11 (Wartime Report No. L-614)*, July, 1945. 55 pp., diagrs. 3 references.

Stability and Control Tests of a 3/8-Scale Model of the XP-69 Airplane in the NACA Full-Scale Tunnel. Harold H. Sweberg. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-642)*, January, 1943. 130 pp., illus. 9 references.

Langley Full-Scale Tunnel Stability and Control Tests of the Bell YP-59A Airplane. Gerald W. Brewer. *U.S., N.A.C.A., Memorandum Report No. L5A18 (Wartime Report No. L-626)*, January, 1945. 79 pp., illus. 3 references.

Measurement of Flying Qualities of a Douglas A-26B Airplane (AAF No. 41-39120). II—Lateral and Directional Stability and Control Characteristics. S. A. Sjoberg, H. L. Crane, and H. H. Hoover. *U.S., N.A.C.A., Memorandum Report No. L5A04 (Wartime Report No. L-606)*, January, 1945. 61 pp., diagrs. 2 references.

Measurement of Flying Qualities of a Douglas A-26B Airplane (AAF No. 41-39120). I—Longitudinal Stability and Control Characteristics. H. L. Crane, S. A. Sjoberg, and H. H. Hoover. *U.S., N.A.C.A., Memorandum Report No. L4L06 (Wartime Report No. L-605)*, December, 1944. 75 pp., illus. 2 references.

Free-Flight-Tunnel Investigation of the Effect of the Fuselage Length and the Aspect Ratio and Size of the Vertical Tail on Lateral Stability and Control. Joseph A. Shortal and John W. Draper. *U.S., N.A.C.A., Advance Restricted Report No. 3D17 (Wartime Report No. L-487)*, April, 1943. 33 pp., illus. 1 reference.

Lateral Stability of the Me-262 Jet Fighter-Bomber (Yaw-Damping Characteristics). Tilch. (*Messerschmitt A.G.*, April, 1945.) *U.S., Army Air Forces, Translation No. F-TS-1117-RE*, July, 1947. 8 pp., diagrs.

High-Speed Wind-Tunnel Tests of a 1/16-Scale Model of a Four-Engine Cargo Airplane. William T. Hamilton. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. A-69)*, February, 1943. 31 pp., illus. 1 reference.

Tests of Inverted Spins in the NACA Free-Spinning Tunnels. George F. MacDougall, Jr. *U.S., N.A.C.A., Advanced Restricted Report No. 3L02 (Wartime Report No. L-370)*, December, 1943. 9 pp., diagr. 6 references.

Wind-Tunnel Investigation of Devices for Improving the Diving Characteristics of Airplanes. Albert L. Erickson. *U.S., N.A.C.A., Memorandum Report No. 3F12 (Wartime Report No. A-66)*, April, 1943. 27 pp., illus. 5 references.

Acceleration Measured at Center of Gravity and Along Span of the Wing of a B-24D Airplane in Landing Impacts. John R. Westfall. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-583)*, August, 1944. 62 pp., illus. 2 references.

Estimation of the Performance and Longitudinal Stability and Control of a Lifting-Body Type of Cargo Airplane from Tests of Simplified Models. D. Feigenbaum. *U.S., N.A.C.A., Memorandum Report No. L5E09a (Wartime Report No. L-541)*, June, 1945. 71 pp., illus. 7 references.

The Effect of the Skis on the Power-Off Stability Characteristics of a Twin-Engine Cargo Airplane. Park Y. Wong. *U.S., N.A.C.A., Memorandum Report No. A5F18 (Wartime Report No. A-74)*, June, 1945. 22 pp., illus. 1 reference.

Correlation Tests of the Ditching Behavior of an Army B-24D Airplane and a 1/16-Size Model. George A. Jarvis and Lloyd J. Fisher. *U.S., N.A.C.A., Memorandum Report No. L6A03 (Wartime Report No. L-617)*, January, 1946. 18 pp., illus. 2 references.

Ditching Tests of a 1/5-Size Model of the Navy SB2C-1 Airplane (Army A-25) in Langley Tank No. 2 and on an Outdoor Catapult. George A. Jarvis and Carl D. Kolbe. *U.S., N.A.C.A., Memorandum Report No. L5L07 (Wartime Report No. L-622)*, January, 1946. 38 pp., illus. 2 references.

XC-35 Gust Research Project, Analysis of Gust Measurements. A. I. Muscovitz. *U.S., N.A.C.A., Restricted Bulletin No. L4D22 (Wartime Report No. L-552)*, April, 1944. 17 pp., illus. 5 references.

Acceleration, Stress, and Deflection Measurements on the XB-15 Bomber in Gusty Air. H. A. Pearson. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-540)*, June, 1939. 32 pp., illus. 2 references.

Development of an Automatic Recording Accelerometer. Albert London. *U.S., Civil Aeronautics Administration, Technical Development Report No. 48*, February, 1945. 32 pp., illus.

The automatic recording accelerometer was developed to ascertain the accelerations experienced by an aircraft during take-off, in flight, while landing, and during taxiing. A bank of preset classifying accelerometer elements governs the circuits of an array of electric styli. Each stylus, when its corresponding circuit is closed, records on electrosensitive paper. The bank is so wired that only the maximum accelerations reached during a shock of greater than 0.02-sec. duration are recorded. The lower and upper acceleration limit of each element defines the acceleration interval between any two consecutive accelerometer elements and may be adjusted to an accuracy of approximately plus or minus 0.15*g*.

Generalized Selection Chart for Bombers Powered by Two, Four, and Six 3000-Horsepower Engines. Maurice J. Brevoort, George W. Stickle, and Paul R. Hill. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-670)*, August, 1942. 45 pp., figs. 2 references.

Generalized Selection Charts for Bombers Powered by Two, Four, and Six 3000-Horsepower Engines. I—Capacity and Economy. Maurice H. Brevoort, George W. Stickle, and Paul R. Hill. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-672)*, January, 1943. 22 pp., figs. 3 references.

Generalized Selection Charts for Bombers Powered by One, Two, Four, and Six 2000-Horsepower Engines. I—Capacity and Economy. Maurice J. Brevoort, George W. Stickle, and Paul R. Hill. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-658)*, September, 1942. 24 pp., figs.

Generalized Selection Charts for Bombers With Four 2000-Horsepower Engines. Maurice J. Brevoort, George W. Stickle, and Paul R. Hill. *U.S., N.A.C.A., Memorandum Report (Wartime Report No. L-669)*, May, 1942. 43 pp., figs. 2 references.

Fuels

Experimental Studies of the Knock-Limited Blending Characteristics of Aviation Fuels. II—Investigation of Leaded Paraffinic Fuels in an Air-Cooled Cylinder. Jerrold D. Wear and Newall D. Sanders. *U.S., N.A.C.A., Technical Note No. 1374*, July, 1947. 30 pp., illus. 2 references.

The Preparation and Physical Properties of Several Aliphatic Hydrocarbons and Intermediates. Frank L. Howard, Thomas W. Mears, and others. *U.S., N.A.C.A., Technical Note No. 1247*, May, 1947. 58 pp., figs. 37 references.

Doelcam Corporation

FLIGHT RESEARCH INSTRUMENTATION

GYROSCOPICS—SERVOMECHANISMS

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Report on the Investigation by Fuels and Lubricants Teams at the I. G. Farbenindustrie A.G. Leuna Works, Merseburg, Germany. *U.S., Bureau of Mines, Information Circular No. 7370*, July, 1946. 135 pp., diagrs.

The individual reports in the compilation describe the processes used for petroleum refining and gas synthesis, coal hydrogenation and the production of oil from coal, coal gasification, oxygen production, the manufacture of alcohols, the synthesis and refining of lubricating oils, and the production of waxes and edible fats. The reports are comprehensive and usually contain an outline of the chemistry of the processes, production figures, flow charts, and production cost analyses. Lists of basic documents that were submitted with the original field reports are included.

Gliding and Soaring

Performance Selection Charts for Gliders and Twin-Engine Tow Planes. H. Reese Ivey, G. M. Fitch, and Wayne F. Schultz. *U.S., N.A.C.A., Memorandum Report No. L5E04* (*Wartime Report No. L-537*), May, 1945. 116 pp., figs. 1 reference.

Tests of the Northrop MX-334 Glider Airplane in the NACA Full-Scale Tunnel. Gerald W. Brewer. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. L-628*), January, 1944. 73 pp., illus. 5 references.

Testing Brake Parachute of Me-321 Transport Glider. Krauss. (*Messerschmitt A.G.*, June, 1941.) *U.S., Army Air Forces, Translation No. F-TS-3104-RE*, July, 1947. 4 pp., fig.

A New Basis of Soaring Flight. Walter Georgii. *Sailplane and Glider*, Vol. 15, No. 7, July, 1947, pp. 2, 3, illus. (Extended abstract of a paper.)

A discussion of the causes and nature of gravity wave motions in the air and of standing ground waves set up by an obstacle on the earth's surface and the utilization of these waves in soaring.

Auto-Towing on Runways. II. S. Falloon. *Sailplane and Glider*, Vol. 15, No. 8, August, 1947, pp. 3, 4, diagrs.

Guided Missiles

Reveal Doppler Tracking for Guided Missiles; Basic Factors Underlying Ingenious Recording Method Outlined in Initial Presentation. *Aviation Week*, Vol. 47, No. 11, September 15, 1947, pp. 28, 30, diagrs.

In the DOVAP system (Doppler Velocity and Position), a stabilized continuous r.-f. wave is transmitted from a fixed ground station to a missile in flight. The wave is received and amplified, and a wave of exactly twice the frequency of the received wave is transmitted to three or more fixed ground stations. The frequency of the missile signal as received at each ground station is heterodyned with twice the frequency of the originally transmitted ground signal. The amount of heterodyning indicates the magnitude of the Doppler effect, from which the velocity and position of the missile can be determined.

Report of Examination and Test of the German Steering Gyro. Henry Friedman. *U.S., Army Air Forces, Technical Report No. F-TR-1147-ND*, June, 1947. 14 pp., illus.

A detailed description of a gyroscope automatic pilot intended to be used with the Fritz X glide bomb and of operational tests. No tests were made for dynamic accuracy.

Ice Prevention

A Flight Investigation of the Meteorological Conditions Conducive to the Formation of Ice on Airplanes. William Lewis. *U.S., N.A.C.A., Technical Note No. 1393*, August, 1947. 52 pp., illus. 14 references.

The results of the meteorological observations conducted during the winter of 1945–1946. The methods of observation and the results obtained are presented and followed by a discussion of the progress made in forecasting the intensity of icing conditions and in defining the maximum icing conditions against which adequate protection should be provided.

Instrumentation for Flight Testing of Thermal Anti-Icing Systems. W. C. Droege. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 6, August, 1947, pp. 695–698. Discussion, p. 698, figs. 8 references.

A suggested standardization of the instrumentation used to obtain data on thermal anti-icing systems. The stations at which thermocouples should be installed and the stations at which air temperatures should be measured are listed. Typical data for dry air and icing conditions are analyzed.

A Method for Numerically Calculating the Area and Distribution of Water Impingement on the Leading Edge of an Airfoil in a Cloud. Norman R. Bergrun. *U.S., N.A.C.A., Technical Note No. 1397*, August, 1947. 48 pp., figs. 6 references.

The water-drop trajectory equations, taking into account deviations from Stokes' law which are caused by the size and velocity of the drop, are modified in order to establish a step-by-step integration method of solution. The method is applicable to any two-dimensional flow for which the streamline velocity components are known or can be approximated. Any number of trajectories can be calculated without the use of a differential analyzer. The error introduced in replacing the airfoil by a cylinder with a radius equal to the leading-edge radius of the airfoil can be estimated. Water-impingement data over the entire airfoil surface can also be obtained. To illustrate the procedure, water-drop trajectories about a 12 per cent thick symmetrical Joukowski profile are calculated.

A Review of Some German Developments in Airplane Anti-Icing. Myron Tribus. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 5, July, 1947, pp. 505–507, figs. 15 references.

The German Air Force found the heated-wing system of anti-icing to be satisfactory. The empirical design basis used by Junkers is described and found to be different from theoretical approaches used by the research groups. The Messerschmitt electrical cycling system is presented, and the results of some meteorological measurements are discussed. The theory of electrically anti-icing propellers had been examined and led to a controlling timer whose on and off cycles were responsive to ambient temperature.

Reports on Various De-Icing Tests. (*Göttingen, Aerodynamische Versuchsanstalt, ZWB/AVAG/38/22/II*, August, 1938.) *U.S., Army Air Forces, Translation No. F-TS-2643-RE*, August, 1947. 17 pp., illus.

Tests to determine the icing characteristics of the double-pane windshield of a cowl for a glider-pilot's seat and those of a dive-brake flap design for gliders. Slits were provided in the outer pane of the windshield for visibility under icing conditions. A condensation tank with its forward end open was connected to the airspace between the panes by a hose. The moisture in the air condensed in the tank. The dry air, which entered the windshield and escaped through the slits, prevented icing of the inside of the panels. Tests were made to determine the extent to which the flap mobility of a wing model 1 m. deep, 0.80 m. wide, and equipped with dive-brake flaps, was reduced by ice deposited under various icing conditions. The results of these tests were used further as standards by which to judge the effectiveness of IG Grease No. 227 as an ice-prevention medium.

Flight Tests of Thermal Ice-Prevention Equipment in the XB-24F Airplane. Carr B. Neel and Alun R. Jones. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. A-7*), October, 1943. 62 pp., illus. 2 references.

Flight Tests of the Thermal Ice-Prevention Equipment on the B-17F Airplane. Bonne C. Look. *U.S., N.A.C.A., Advance Restricted Report No. 4B02* (*Wartime Report No. A-23*), February, 1944. 53 pp., illus. 3 references.

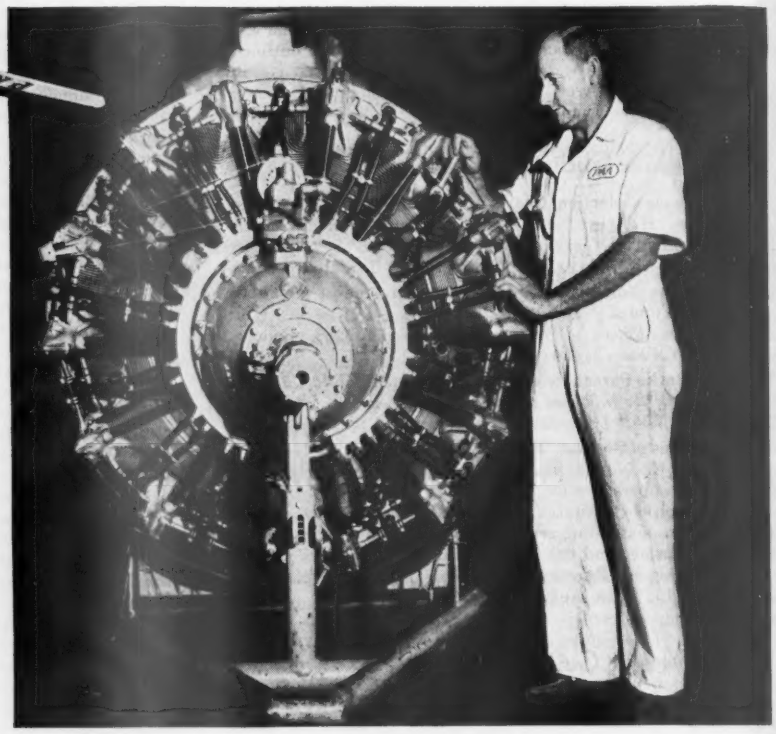
Icing Zones in a Warm Front System with General Precipitation. William Lewis. *U.S., N.A.C.A., Technical Note No. 1392*, July, 1947. 16 pp., figs. 3 references.

Instruments—General

German Design and Production of Optical Measuring Instruments. K. J. Hume, S. T. Hold, and F. J. Knight. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 1322.* 30 pp., illus. British Information Services, New York. $1.00.

Rate-Detecting Gyro. Victor J. Canziani. *Machine Design*, Vol. 19, No. 8, August, 1947, pp. 142–144, illus.

The gyro developed by the Fairchild Camera and Instrument Corporation is capable of detecting rate changes ranging between 3.36° per min. and 30° per sec. at a velocity of 1,800° per min. The precession of the gyro is taken out by an inductive take-off mounted on the gimbal frame. The direction sense on either side of the neutral position is obtained by the phase-change characteristic of the take-off. The dimensionally stable metals, the



Pan American comments on AMERICAN SHIELDING CONDUIT

THIRTEEN LEADING AMERICAN, and many foreign, airlines have acclaimed American HTCD Electrical Shielding Conduit as the outstanding ignition shielding available today. Here is what Mr. B. W. Risinger, Power Plant Engineer of the Latin American Division of Pan American World Airways System, has to say about HTCD:

"The Neoprene-covered type of ignition shielding, as manufactured by The American Brass Company, is superior to the metal shielding previously used by PAA, because it dampens out the vibration which, in the past, too often caused failure of the shielding's waterproof quality. This new type of shielding tends to last three to four times as long as that formerly used."

American HTCD Shielding Conduit eliminates all possibility of radio "noise nuisance" in primary leads, ignition and other wiring. It is built to combine exceptional mechanical strength with the ultimate in electrical shielding characteristics. Literature on request. 47312

"HTCD—D" TYPE CONDUIT

An inner core of fully interlocked stainless steel flexible tubing is covered with two carefully designed layers of tinned copper wire braiding. A molded synthetic cover gives complete protection against dirt, dust, oil and other foreign substances.

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plastic parts, and the plastic bonding of the transformer laminations enable the instrument to withstand wide ranges of temperature and high orders of shock.

Instruments, Engine

Adoption of Gravimetric Fuel-Quantity Gages and Fuel-Flow Meters for Aircraft. J. A. Townsend and Kenneth W. Beckstrom. *U.S., Air Force, Air Technical Intelligence, Technical Data Digest*, Vol. 12, No. 7, October 1, 1947, pp. 7–12, figs.

The Air Force has ordered that all aircraft fuel-flow and fuel-quantity gages for service use be calibrated in gravimetric units. The variation in density of different fuel grades and the variation in density of fuels with temperature make accurate computation of the gross weight of the aircraft difficult. Direct reading of the quantity of fuel in pounds facilitates the computation of the gross weight of the aircraft and permits setting up of the optimum engine operating conditions for maximum cruising efficiency. Capacitance fuel-quantity gages have been developed which indicate with high accuracy the amount of fuel in the tank and compensate for those variations in fuel level which do not depend on the quantity of fuel.

Determination of the Thermal Correction for a Single-Shielded Thermocouple. W. M. Rohsenow and J. P. Hunsaker. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 6, August, 1947, pp. 699–703. Discussion, pp. 703, 704, diagrs.

In order to determine the temperature of a hot gas flowing in a duct, it is necessary to take into account the heat radiation between the walls of the duct and the thermocouple. A single-shielded thermocouple has been designed which permits a smaller thermal correction to be applied than that required by a bare thermocouple. A rapid graphic method is given for determining the deviation between the reading of the single-shielded thermocouple and the true gas temperature.

Description of a Temperature Indicator for 300° to 1000°C. (*Luftfahrtgerätewerk Hakenfelde G.m.b.H.*, November, 1944.) *U.S., Army Air Forces, Translation No. F-TS-1914-RE*, July, 1947. 9 pp., diagrs. Directions for installing and testing an exhaust-gas bimetal thermometer. Circuit diagrams of the transmitter and the indicator are given. The thermometer is accurate to within plus or minus 50°C.

Novel Method of Determining Incipient Engine Knock. F. Lichtenberger. (Knock Indicator Based on the Principle of Pressure Acceleration, *Verein Deutscher Ingenieure, Zeitschrift*, March 21, 1942.) *Automotive Industries*, Vol. 97, No. 3, August 1, 1947, pp. 30, 31, 60, figs.

The method, based on pressure acceleration, uses a piezoelectric pickup, an amplifier, and an oscillograph to obtain a complete curve of pressure acceleration against changing pressures. The curve gives positive and objective determination of the point of incipient knock. The novelty of the method lies in the evaluation procedure, which consists of a determination of the point where knock begins on a curve covering the whole range of operations. By this limiting-charging-pressure method, it is possible to compare not only different fuels in the same engine but also different engines on the same fuel.

Instruments, Flight

Cathode-Ray Compass. *Product Engineering*, Vol. 18, No. 8, August, 1947, pp. 132–134, diagrs. (Extended abstract of a paper: A Magnetic Compass with a Cathode-Ray Sensing Element, Waldo H. Kliever and Richard R. Syrdal.) (Cf. AER 5/47:47.) Description and block and circuit diagrams of the Minneapolis-Honeywell Cathotrol compass.

Instruments, Meteorological

Radio Meteorograph Data. I—Description and Technical Specifications for the Radiosonde RfW Model Lang. (*D(Luft) 1704-1*, December, 1942.) *U.S., Army Air Forces, Translation No. F-TS-1098-RE*, July, 1947. 24 pp., diagrs.

Gurley Wind Velocity and Wind Direction Instruments. *W. and L. E. Gurley, Bulletin No. 6000*, 1947. 20 pp., illus.

Descriptions, catalog numbers, specifications, mounting directions, and prices of Gurley anemometers, wind-direction instruments, wind-recording instruments, and pilot-balloon theodolites.

Insurance, Safety, and Rescue

Survey of Accidents and Present Difficulties in Jet Planes in the Continental U.S. Army Air Forces. L. A. Sheppard. *The Journal of Aviation Medicine*, Vol. 18, No. 3, June, 1947, pp. 297–301. 4 references.

An analysis of the 28 major aircraft accidents that have occurred during the 5,523 hours of flying time accumulated by jet aircraft as of January 1, 1946.

Insurance Aspects of Air Navigation. Jerome Lederer. *Western Flying*, Vol. 27, No. 8, August, 1947, pp. 17, 28, illus. (Cf. AER 9/47:55.)

Airline Safety Record Not Bad—But Not Good Enough. Richard H. Rush. *Air Transport*, Vol. 5, No. 8, August, 1947, pp. 32–35, illus. An analysis of aircraft accidents and a comparison with the accident rates of other means of transportation.

Landing Gear

A Critical Study of Aircraft Landing Gears. J. F. McBrearty. *Lockheed Aircraft Corp.* (For abstract see "I.A.S. Briefs" on page 18 of this issue, November, 1947.)

Castored Wheels Enable Directional Takeoff (Goodyear Aircraft Corp.). *Product Engineering*, Vol. 18, No. 8, August, 1947, p. 95, diagr.

Lubrication and Lubricants

Scoring and Burnishing in Bearings. V. H. Brix. *Aircraft Engineering*, Vol. 19, No. 221, July, 1947, pp. 218–221, illus.

Experiments were conducted which showed that scoring and burnishing can be produced without the surfaces touching while in motion. The modification of the surfaces appears to be the effect of a change in acceleration within the lubricant caused by minute surface irregularities. This motion within the lubricant results in high shearing stresses that may be sufficient to disrupt metallic debris on a submicroscopic scale. Once the erosion has begun the succeeding layers that are exposed seem to be even less resistant to the fluid action. The process continues until a channel or score is worn into the metal surface.

Esters as Lubricants. Zorn. (*IGF/RES/Zor*, November 11, 1943.) *U.S., Army Air Forces, Translation No. F-TS-957-RE*, July, 1947. 22 pp., figs.

Materials—General

Preliminary Investigation of a Gas Turbine with Sillimanite Ceramic Rotor Blades. Frederick J. Hartwig, Bob W. Sheflin, and Robert J. Jones. *U.S., N.A.C.A., Technical Note No. 1399*, July, 1944. 27 pp., illus. 10 references.

Two blade forms were designed and manufactured. The design of the second blade was developed to give increased strength and correct the cause of failure of the first design. The simplification of the second design to facilitate fabrication resulted in a blade that is slightly less desirable aerodynamically. The operational results of tests with these blades in a turbine are presented with a description of the blade designs, dimensional inspection, and heat-shock tests. No determinations of aerodynamic performance were made because operating speeds were below the design value. Results showed that ceramic-blade turbines can be operated at inlet-gas temperatures of 1,800° to 2,000°F. and moderate speeds for short life.

Analytical Methods of Investigating Some Highly Refractory Carbides and Nitrides (SiC, B_4C, BN) (Project No. KQ-253). Hans Bielstein. *U.S., Army Air Forces, Technical Report No. F-TR-1154-ND (GS-AAF-Wright Field No. 34)*, August, 1947. 14 pp.

The report discloses special methods for the exact quantitative analysis of silicon carbide, boron carbide, boron nitride, and their common impurities. Descriptions of the procedures, sufficiently detailed to enable any skilled analyst to execute the analyses, are provided. These descriptions are not to be found in other works on analytical chemistry and were the results of experience gained during the course of research conducted in the analytical laboratory of the Electro-Schmelzwerk, Kempten-Allgaeu.

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Aircraft Instruments

A Micro-Hardness Tester. H. Lloyd. *Journal of Scientific Instruments*, Vol. 24, No. 7, July, 1947, pp. 186–189, illus.

The instrument was developed by the British Safety in Mines Research Board to determine the hardness of a specimen at a microscopically determined point. An adapter that contains a calibrated spring and a standard Vickers diamond point replaces the objective of the microscope. When the point is lowered to the specimen, a compression load is sustained by the spring. This causes the circuit of an indicator light to be opened. The objective is then replaced, and the identation is measured through a calibrated eyepiece.

Japanese Air Force Textiles. *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.O.S./J.A.P./P.R./245*, December 6, 1945. 16 pp. British Information Services, New York. $0.45.

Materials—Metals and Alloys

Precipitation-Hardened Alloys for Gas-Turbine Service. I—Metallurgical Considerations. II—Design and Application Data. Howard Scott and R. B. Gordon. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 6, August, 1947, pp. 583–599, illus.

A detailed account of the steps taken and the metallurgical principles used in the development of a high-temperature alloy. The example taken is an alloy with good machinability and amenability to plastic deformation which would be suitable for turbine blades. **I.** The reason for the selection of the base alloy and the hardeners is explained. Data from short-time tensile and creep rupture tests are plotted for specimens with various compositions and for specimens that had been given differing heat-treatments. From these curves the alloy with the optimum combination of properties is selected. **II.** Design curves that plot the total strain against the test load for a given temperature are given for four alloys: Discaloy, K42B, Refractoloy 26, and Refractaloy 70. From these graphs the load can be interpolated to a reference time to provide a value of creep strength for a specified deformation. The temperatures selected are in the range 1,200° to 1,600° F. These data permit an evaluation of the alloys with reference to other alloys on which service experience is available. The factors governing the choice of alloys for rotors and blading and the effects of forging, machining, welding, and heat-treating of gas-turbine components are discussed.

Haynes Alloys for High-Temperature Service. W. O. Sweeney. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 6, August, 1947, pp. 569–580. Discussion, pp. 580, 581, illus.

A detailed summary of the properties of high-temperature precision-casting alloys and their advantages for gas-turbine blade application. Tables and graphs give detailed test data for nine casting alloys developed by the Haynes Stellite Company. The various applications in which they have been used are listed. Graphs are given in which are compared the secondary rupture and life-to-rupture characteristics at high temperatures of wrought alloys whose characteristics are a result of heat-treatment and alloys that are used in the cast condition. The superiority of cast materials over wrought materials at temperatures above 1,500°F. indicates that the investment or precision method of casting could be used to advantage in the production of high-temperature gas-turbine parts.

Materials for Power Gas Turbine. C. T. Evans, Jr. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 6, August, 1947, pp. 601–608, illus. 12 references.

The alloys 19-9 W-Mo and S-590 have been selected for the rotors and blades of gas turbines because of their good retention of ductility at high temperatures. This quality should help to minimize the effects of repetitive thermal stresses. Design factors and construction details are discussed from the standpoint of materials which will allow a machine life of 100,000 hours.

Metallurgical Considerations of Gas Turbines. N. L. Mochel. *American Society of Mechanical Engineers, Transactions*, Vol. 69, No. 6, August, 1947, pp. 561–568. Discussion, p. 568, illus. 13 references.

A general discussion of the metallurgical properties required of the materials used in gas-turbine construction. Conventional materials-testing procedures do not yield data from which to evaluate the characteristics of materials exposed to the high operating temperatures of turbines. Test methods and equipment are described from which adequate data can be obtained. The various types of alloys and their fabrication for hot part application are outlined.

A Metallurgical Investigation of a Large Forged Disc of Low-Carbon N-155 Alloy. J. W. Freeman and H. C. Cross. *U.S., N.A.C.A., Advance Restricted Report No. 5K20 (Wartime Report No. W-103)*, December, 1945. 41 pp., illus. 4 references.

Limitations on Precision Parts. Nicholas J. Grant. *The Iron Age*, Vol. 160, No. 6, August 7, 1947, pp. 62–66, illus.

An investigation of the limitations of the investment casting process for the casting of turbine rotor blades. Radiographic examination of cast blades indicates that, in extreme sizes and shapes, creep and rupture data obtained from test billets are not entirely adequate for the evaluation of blade performance. The size and shape limitations shown by the blades examined are consistent with standard foundry principles. The limitations can be overcome by proper feeding of the liquid metal to shrinking solidifying sections. This can be done by using centrifugal casting, improving gating and risering, and providing sufficient taper in the blade section to permit directional solidification.

A New Method of Spectrographic Analysis. R. Ricard and N. Cornu. (*Revue de Métallurgie*, Vol. 42, No. 12, December, 1945, pp. 389–392.) *Engineers' Digest*, Vol. 4, No. 7, July, 1947, pp. 311, 312, diagrs. 3 references.

The method, intended for industrial quantitative analysis, permits the direct comparison of the lines of one metal of unknown concentration in a test sample with similar lines of a calibrated standard sample. The usual spectrograph slit is replaced by a reflecting cylinder of small diameter. Two light sources are used, and the spectra of the known and unknown materials are projected and focused together on a photographic plate.

Gamma-Ray Radiography for Inspection Work; A Comparison with X-Ray Technique. J. C. Chaston. *Aircraft Production*, Vol. 9, No. 106, August, 1947, pp. 309–311, illus.

A description of the technique employed in the examination of castings by gamma rays. The radium which is the source of the rays is contained in a portable housing made of copper-tungsten sintered metal which affords ample protection to the operator. Although gamma rays do not give as sharp a contrast as X-rays between the light and dark portions of the photographic image, the range of sections that can be examined with a single exposure, the absence of scattered radiation at the edges of the object, and the high penetrating power make the gamma-ray method a valuable supplement to X-ray examination.

Engineering Significance of Metals Testing. Blake D. Mills, Jr. *The Iron Age*, Vol. 160, No. 6, August 7, 1947, pp. 78–83, diagrs. 4 references.

New Process for Production of Pure Metallic Tungsten (Project No. KQ-242). Hans Bielstein. *U.S., Army Air Forces, Technical Report No. F-TR-1150-ND*, August, 1947. 6 pp., chart.

Cast Tungsten Carbide and the Production of a Tungsten Free Hard Metal. Report of Interrogation of Joost Rietveld, Engineer, Rochling Buderus, Berlin, by W. Ivory. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 1076, Item No. 21.* 74 pp., diagrs.

The Effect of Stabilizing and Stress Relief Heat Treatment on Welded 18-8 Stainless Steel. Wilson G. Hubbell. *Aircraft Engineering*, Vol. 19, No. 221, July, 1947, pp. 225–228, illus.

Aluminum-Clad Light Alloys. *Engineering Materials*, Vol. 5, No. 18, August, 1947, pp. 90, 91, tables. An outline of the structure and properties of Alclad. British Standards are given for eight types. Six continental types are described.

Aluminum Refining and Scrap Recovery at V.A.W. Erftwerk Grevenbroich. H. R. Williams. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 1089, Item No. 21.* 56 pp., illus. British Information Services, New York. $1.60.

Magnesium Replaces Fabric for Aircraft Control Surfaces. R. E. Saunders. *Materials and Methods*, Vol. 26, No. 2, August, 1947, pp. 88–92, illus.

The substitution of sheet magnesium for the fabric skin of the Beechcraft Bonanza resulted in greater strength, fewer parts, less weight, lower tooling costs, and a saving in labor.

The Aluminum Reduction Industry in Germany. A. J. Rice and Francis C. Frary. *U.S., Field Information Agency, Technical, Final Report No. 993*, November 14, 1946. 26 pp., 10 references. British Information Services, New York. $0.90.

Improved Engineering Properties of Parts Made from Iron Powders. Claus G. Goetzel. *Product Engineering*, Vol. 18, No. 8, August, 1947, pp. 115–119, figs.

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Materials—Plastics and Plywood

I. G. Farbenindustrie Plastics File. *U.S., Army Air Forces, Translation No. F-TS-2466-RE,* June, 1947. 866 pp.

The card file on synthetic materials which was kept by the main library of the I. G. Farbenindustrie contained information on raw materials, processes, products, applications, theory, research, and development in plastics and allied fields. It also contained trade names, trade marks, business statistics, and material on legal and economic subjects that pertain to the industry. The information was obtained from the reports of the various subdivisions of the I. G. Farben organization, from patent applications, commercial formulation, and current literature throughout the world. The information was prepared in the form of abstracts that were distributed to the various units of the company where they might be of interest. The abstracts were detailed and informative. In many cases they contained diagrams and graphic formulas. A numerical-alphabetical key was used which contained the following major headings: Synthetic Materials through Synthesis; Applications; and General. Under the latter heading were included Research, Methods, Analysis and Materials Testing, Statistics, Industrial Hygiene, and Literature. The major headings had the following typical subclassifications: Organic and Inorganic Raw Materials, Protein Materials, Ethers and Acetals, After-Treated Polymers, After-Treated Condensation Products, Surface Protection and Treatment (Lacquers and Coatings), Special Fabrication, Coloring and Effect Materials, Additives, and Apparatus. About three thousand of these entries and abstracts have been translated and arranged according to the original numerical-alphabetical key. No cross reference is provided, but those items that were given more than one classification in the original file are given their secondary index numbers. They are reproduced only under their primary classification. The compilation does not contain the complete file. As more material is translated, supplements to this volume will be published.

Woods and Glues Used on Japanese Aircraft. W. A. Corry. *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.O.S./J.A.P./P.R./173,* November 19, 1945. 9 pp., tables. British Information Services, New York. $0.35.

Layout of Plywood Factories; Interrogation of Dr. Ernest Doffine. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 602 (Appendix) (Interrogation Report No. 385).* 5 pp. British Information Services, New York. $0.35.

Medicine

Analysis of Factors Contributing to 460 "Pilot-Error" Experiences in Operating Aircraft Controls. *U.S., Army Air Forces, Air Materiel Command, Aero Medical Laboratory, Memorandum Report No. TSEAA-694-12,* July 1, 1947. 32 pp. 10 references.

Studies of Visual Discrimination Time: The Time Required to Recognize Simple Patterns at Equal Distances from the Eye, and Patterns at Alternately Far and Near Distances. *U.S., Army Air Forces, Air Materiel Command, Engineering Division, Aero Medical Laboratory, Memorandum Report No. TSEAA-694-1H,* July 10, 1947. 24 pp. 16 references.

Discussion of Pictorial Versus Symbolic Aircraft Instrument Displays. *U.S., Army Air Forces, Air Materiel Command, Aero Medical Laboratory, Memorandum Report No. TSEAA-694-8B,* August 4, 1947. 19 pp.

The Independence of Tracking in Two and Three Dimensions with the B-29 Pedestal Sight. *U.S., Army Air Forces, Air Material Command, Aero Medical Laboratory, Memorandum Report No. TSEAA-694-2G,* August 8, 1947. 16 pp., tables. 3 references.

Factors Affecting Dark Adaptation. Heinrich W. Rose and Ingeborg Schmidt. *The Journal of Aviation Medicine,* Vol. 18, No. 3, June, 1947, pp. 218–230, 243, figs. 47 references.

Russian and German literature on the factors that affect dark adaptation is outlined. A number of experiments were conducted in which the effects of caffeine-metrazol, muscular exercise, strychnine, ultrasonic vibrations, ephedrine, octin, the stimulation of taste, and vitamin A both in oil solution and in emulsion were tested. An analysis of the results by the statistical method gave no convincing evidence that night vision had been improved or impaired by any of the factors tested.

Army-Navy Research Will Probe Supersonic Sickness. *Aviation Week*, Vol. 47, No. 7, August 18, 1947, p. 17, illus.

The Wright Field Aero Medical Laboratory is constructing a sound chamber that will be used to determine the effect of inaudible sound vibrations in the vicinity of 20,000 cycles per sec. on human health. The Naval Air Experimental Station is conducting less exhaustive but similar tests by subjecting volunteers to the noise of a jet engine in the test cell and submitting them to a medical examination as they leave.

Oxidase and Aviation; Influence of Atmospheric Decompression on the Blood Oxidase and Resistance to Infection. Paulo Seabra. *The Journal of Aviation Medicine*, Vol. 18, No. 3, June, 1947, pp. 289–296, illus. 3 references.

Incidence of Decompression Sickness in Individuals Tested in a Decompression Chamber Situated at 4,700 Feet. Richard W. S. Cheetham. *The Journal of Aviation Medicine*, Vol. 18, No. 3, June, 1947, pp. 279–288.

The Prevention of Altitude Pain by Preselection. Franklin M. Henry. *The Journal of Aviation Medicine*, Vol. 18, No. 2, June, 1947, pp. 259–265, 296, tables. 6 references.

Studies on Positive Pressure Respiration. IV—Subjective, Clinical and Psychological Effects of Continuous Positive Pressure Breathing at High Altitudes. Alvan L. Barach, Morris Eckman, and others. *The Journal of Aviation Medicine*, Vol. 18, No. 3, June, 1947, pp. 252–258, 305, tables. 1 reference. (Cf. AER 7/47:55.)

Prolonged Hypoxia in Aircraft Passengers; The Effects of a Flight Around the World in Six and One-Quarter Days. M. S. White. *The Journal of Aviation Medicine*, Vol. 18, No. 3, June, 1947, pp. 244–251, 288, figs. 4 references.

The Adaptations Which Produce Acclimatization to Oxygen Lack. Charles S. Houston. *The Journal of Aviation Medicine*, Vol. 18, No. 3, June, 1947, pp. 237–243, figs. 8 references.

Are the Intervertebral Disks Displaced During Positive Acceleration? Charles F. Code, Marvin M. D. Williams, and others. *The Journal of Aviation Medicine*, Vol. 18, No. 3, June, 1947, pp. 231–236, 296, illus. 1 reference.

Nasal Resistance Inhaler: A New Method for the Prevention and Treatment of Aerotitis Media and Aerosinusitis. H. J. Sternstein. *The Journal of Aviation Medicine*, Vol. 18, No. 3, June, 1947, pp. 266–278, illus. 6 references.

Meteorology

The I.C.A.N. Standard Atmosphere. *Aircraft Engineering*, Vol. 19, No. 221, July, 1947, p. 224, chart.

A nomogram from which meteorological conditions at altitudes up to 60,000 ft. can be computed. The chart is intended as an aid in calculating the performance of conventional and jet engines.

Progress Report on Objective Rainfall Forecasting Research Program for the Los Angeles Area. J. C. Thompson. *U.S., Weather Bureau, Research Paper No. 25*, July, 1946. 35 pp., figs. 9 references.

Forecasting the Time of Formation of Stratus Cloud Ceiling at Oakland, California, Airport. Edward M. Vernon. *U.S., Weather Bureau, Research Paper No. 23*, April, 1945. 9 pp., fig.

Investigation of Polar Anticyclogenesis and Associated Variations of the Zonal Index. Jerome Namias. *U.S., Weather Bureau, Research Paper No. 24*, September, 1945. 22 pp., figs. 11 references.

Improvement of Trend Methods of Forecasting. Phillip F. Clapp. *U.S., Weather Bureau, Research Paper No. 5*, July 5, 1943. 6 pp.

A Collection of Reports on the Preparation of Prognostic Weather Charts. *U.S., Weather Bureau, Research Paper No. 21*, October, 1944. 23 pp., figs.

Contains the following papers: Methods for Preparing Short-Range Prognostic Charts, J. R. Fulks; Methods for Preparing Mean Virtual Temperature Charts, H. B. Wobus; and An Outline of Methods Used in the Preparation of a 24-Hour Prognostic Chart, S. Teweles.

A Collection of Reports on Extended Forecasting Research. *U.S., Weather Bureau, Research Papers Nos. 2–4, 7–11*, January, 1944. 71 pp., figs.

Contains the following Research Papers: No. 2, A Project to Test the Potential Usefulness of Pressure Patterns for Forecasting, Horace W. Norton, Glenn W. Brier, and Roger A. Allen; No. 3, Preliminary Report on Duration of Stormy Periods at Selected Localities and Intervals Between Periods, Leonard L. Weiss; No. 4, Some Relationships Between Five-Day Mean Surface Maps, Charles B. Johnson; No. 7, Formation of New Moving Centers South of Deep Lows (Preliminary Report), Robert C. Gentry; No. 8, An Investigation of a Trajectory Method for Forecasting Flow Patterns at the 10,000-Foot Level, Herbert G. Dorsey, Jr., and Glenn W. Brier; No. 9, Preliminary Report on Stagnant Highs over Greenland, Iceland, and England, and over the Bering Sea and Alaska in July and August, Robert C. Gentry and Leonard L. Weiss; No. 10, Persistence in London Temperatures, Horace W. Norton and Glenn W. Brier; No. 11, Skill in Selecting the "Best" Forecast, Glenn W. Brier.

Verification of a Forecaster's Confidence and the Use of Probability Statements in Weather Forecasting. Glenn W. Brier. *U.S., Weather Bureau, Research Report No. FR-16*, February, 1944. 10 pp.

Military Aviation

Administrative History of U.S. Army Air Forces. George E. Stratemeyer. *Air Affairs*, Vol. 1, No. 4, Summer, 1947, pp. 510–525.

The Simulation of Radar Presentations for Briefing Purposes. Joseph Westheimer. *Society of Motion Picture Engineers, Journal*, Vol. 48, No. 6, June, 1947, pp. 586–590, illus.

New Gear Assists in Bomb Loading. *Naval Aviation News (Naval Air Reserve Edition)*, No. 4, August, 1947, p. 29, illus.

Naval Aviation

Administrative History of U.S. Naval Aviation. Donald B. Duncan and H. M. Dater. *Air Affairs*, Vol. 1, No. 4, Summer, 1947, pp. 526–539.

Photography

High-Speed Photography. I—External Surfaces and Opaque Objects. G. A. Hawkins and C. E. Balleisen. *Machine Design*, Vol. 19, No. 8, August, 1947, pp. 127–133, illus. 15 references.

A brief description of the principles and the operation of the displacement camera as used to record the relative movements of machine parts and oscilloscope traces, high-speed single- and multiple-exposure photography, and schelieren photography in the analysis of high-speed motion.

Experiments to Increase the Stability of Supersensitized Infrared Films by Organic Stabilizers. U. Schmieschek. (*Deutche Versuchsanstalt für Luftfahrt, ZWB/FB/908*, February, 1938.) *U.S., Army Air Forces, Translation No. F-TS-2097-RE*, August, 1947. 6 pp., figs.

Production Methods

Precision Casting of High-Nickel Alloys by the "Lost Wax" or Investment Process. H. Evans, P. S. Cotton, and J. Thexton, *Aircraft Production*, Vol. 9, No. 106, August, 1947, pp. 303–307, illus. 8 references.

The lost-wax or investment method of casting is an economical method of producing castings with close dimensional accuracy and surface smoothness from materials that cannot be machined practically. A wax pattern of the object to be cast is coated with a refractory material. This coating becomes the final mold after the wax has been melted out. The process is described as it was used in the production of high temperature turbine blades of Nimonic 80 alloy. Details are given of the development of the high temperature refractory materials used for the original spray coating of the wax pattern and the investment mold.

Conic Lofting of Streamline Bodies. Roy A. Liming. *Aircraft Engineering*, Vol. 19, No. 221, July, 1947, pp. 222, 223, 228, figs.

The streamline requirements of high-speed aircraft have led to the use in lofting techniques of a projective theory of the conic, which is based on theorems of Pascal and Brianchon. North American Aviation, Inc., has made the use of graphic projections unnecessary by applying the analytic theory of the conic to the basic dimensions of the airplane shape to be constructed. This device eliminates the physical limitations, graphic errors, and

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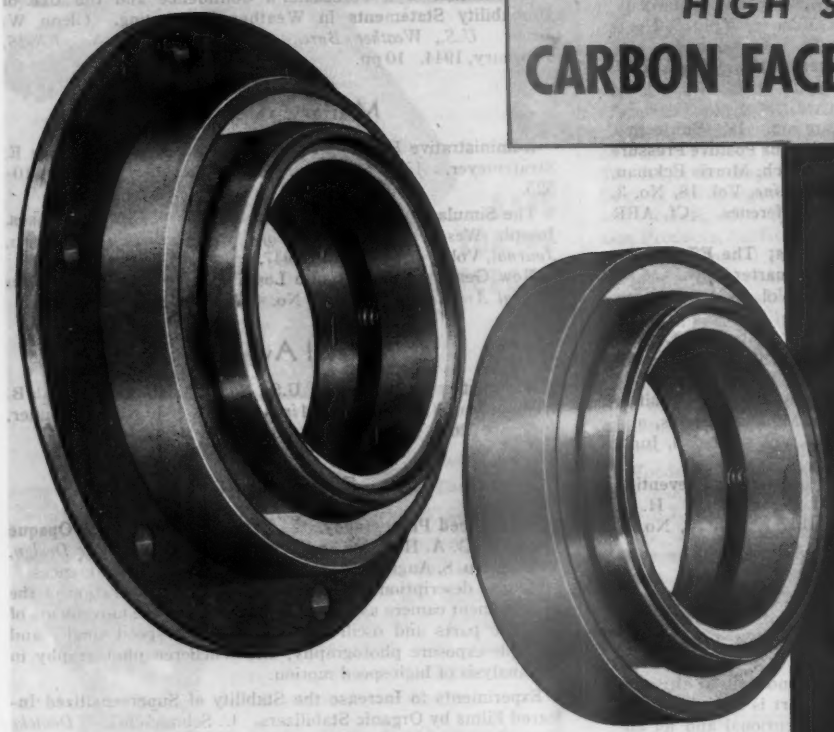

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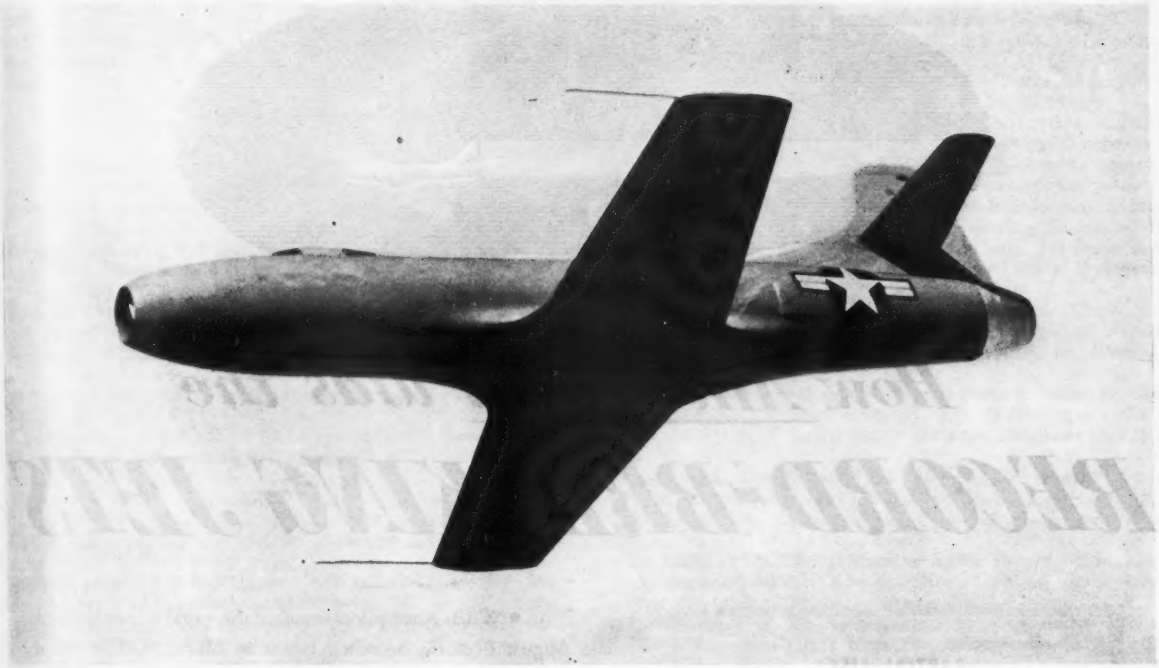

The Douglas D-558 Skystreak during its record-breaking flight of 650.6 m.p.h. at Muroc.

construction tolerances which are sources of inaccuracies in conic constructions. Any desired degree of accuracy can be obtained and modifications and redesign can be quickly and positively re-oriented.

Stage-Die Development. *Aircraft Production*, Vol. 9, No. 106, August, 1947, pp. 301, 302, illus.

In the Sol-A-Die method of developing die patterns, which has been developed by the Solar Aircraft Company, a flexible pattern of laminated cheesecloth and beeswax is prepared from the final forming die. The pattern is flattened out into as many intermediate forms as are necessary for the various stages to no slopes greater than 20°. For each stage an intermediate die is struck. The metal is first deformed to the shallowest possible counterpart of the final die in which all the differential areas are expanded to the size required in the final part. The shearing and tearing actions usually associated with deep draws are thus eliminated.

Machining Landing-Gear Hubs. *Aircraft Production*, Vol. 9, No. 106, August, 1947, pp. 312–315, illus. A description of turret-lathe tooling methods used by the Dunlop Rubber Company, Ltd., in the manufacture of wheel hubs for the landing gear of the Avro York.

Light Alloys; Notes on German Technique on Continuous Casting and Extrusion of Aluminum Alloys with Particular Reference to Tube Extrusion, Tube Reducing Machines and Vertical Extrusion Presses. H. J. Lajus. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 981.* 20 pp., diagrs. British Information Services, New York. $0.70.

Electro-Erosion Cutting of Hard Metal and Steel. T. P. Rekshinskaia. (*Avtomobil'naia Promyshlennost'* (U.S.S.R.), No. 5-6, 1946, pp. 12–15.) *Engineers' Digest*, Vol. 4, No. 7, July, 1947, pp. 304, 305, diagrs.

Description of the Gorki Automobile Works' machine for cutting high-speed carbide tool steels. A rotating disc and the bed of the machine form two electrodes of a d.c. circuit. A spark is produced between the specimen to be cut and the disc. Particles of the metal are removed from the anode surface (the specimen) through an electrolyte. Factors affecting performance are analyzed.

New Expediting Techniques Proved in XB-48 Productions; How Tooling, Procurement, and Construction Problems Were Overcome by Martin in Fast Fabrication of Its Large Experimental Jet Bomber. Irving Stone. *Aviation Week*, Vol. 47, No. 10, September 8, 1947, pp. 26, 29, 30, 33, illus.

The Aérosudest SE-2010 in Production. *Aircraft Engineering*, Vol. 19, No. 221, July, 1947, pp. 233–238, 240, illus.

A detailed description of production methods illustrated by photographs of the work in progress in factories at Paris, Toulouse, and Marignane. This four-engined 70-ton mid-wing passenger transport is the first of twenty-four that are being mass produced without benefit of prototype testing.

Gloster Meteor; Manufacture of the Mark IV Version. I—Centre-Section Assembly. S. C. Poulsen. *Aircraft Production*, Vol. 9, No. 106, August, 1947, pp. 289–295, illus.

Ball and Roller Bearings; Production Methods in Five Factories. R. Campagnolo and E. S. Clarke. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 1242, Item Nos. 21, 31.* 118 pp., illus. British Information Services, New York. $3.25.

High Pressure, High Temperature Process Heating, 250 Atm. Ernest W. Halbach. *U.S., Field Information Agency, Technical, Final Report No. 725*, March 20, 1946. 10 pp. diagrs. 4 references. British Information Services, New York. $0.30.

Photo-Projection Inspection and Layout. C. J. Kettler. *The Iron Age*, Vol. 160, No. 5, July 31, 1947, pp. 45–49, illus.

A simple and rapid method of inspecting and laying out intricate castings. Manufacturers' drawings are reproduced on glass slides at a 1:25 scale and projected on the appropriate face of the casting. The distance of the projector from the casting can be varied to give the projection dimensional accuracy in any desired plane. To indicate this plane, a second light source, which is controlled by a servomechanism linked to the projector, moves above the casting throwing a narrow band of light in the plane of dimensional accuracy. A maximum error of 0.040 in. has been attained.

Production Tools and Equipment

Production Pipe-Bending; Forming Without Fillers; A Power Machine for Rapid Output. L. G. Burnard. *Aircraft Production*, Vol. 9, No. 106, August, 1947, pp. 298–300, figs.

Development of a Special Drill for Plexiglas Fabrication. Beckh. (*W. Kopperschmidt und Soehne*, May, 1942.) *U.S. Army Air Forces, Translation No. F-TS-911-RE*, July, 1947. 38 pp., illus.

How AiResearch aids the RECORD-BREAKING JETS

PARTIAL LIST OF JET AIRPLANES USING AIRESEARCH CABIN PRESSURE AND REFRIGERATION EQUIPMENT

	CABIN PRESSURE	REFRIGERATION
Consolidated XB-46	x	x
Consolidated XP-81	x	x
Curtiss XP-87	x	x
Douglas XB-43	x	x
Douglas D-558 (Navy)	x	x
Lockheed P-80B	x	x
Martin XB-48	x	
McDonnell XF2D-1 (Navy)	x	x
North American B-45	x	x
Northrop YB-49		x
Republic P-84	x	x

• When Navy pilots smashed the world's speed record last August over the scorched desert at Muroc, California, a midget AiResearch turbine refrigeration unit tossed snow flakes into the cockpit of the Douglas jet-powered D-558 *Skystreak!*

During the first runs which averaged 640.7 m.p.h., skin temperatures of the *Skystreak,* lashed by air friction and heat of the sun, were about 165 degrees F. Bleed air from the jet engine, source of air for the turbine, was a searing 450 degrees. Yet the AiResearch turbine discharged air into the cabin between 30 and 40 degrees, keeping cabin temperature to approximately 90°.

Thus the extreme cockpit temperatures encountered today in high-speed jet-propelled planes are being successfully controlled by unique AiResearch turbine refrigeration units. For the past eight years this company has pioneered the field, designed and built the first experimental models, and is today equipping a major share of all jet-propelled airplanes under construction or flying in the United States.

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Tiny 3 pound AiResearch turbine, the heart of the Skystreak refrigeration system, operates at speeds up to 100,000 r.p.m. — delivers 7 pounds airflow per minute. When coupled with an AiResearch heat-exchanger, air temperatures can be dropped over 450°F.

CABIN PRESSURE REGULATOR

A 4½ pound pressure regulator with a 10 pound per minute airflow capacity controls cabin pressure in the Skystreak by automatically governing the outflow of the cooled pressurized air from the cabin.

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Propellers

Determination of the Optimum Twist of an Airscrew Blade by the "Calculus of the Variations." C. N. H. Lock, R. C. Pankhurst, and R. G. Fowler. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2088*, January, 1942. 27 pp., figs. 9 references. British Information Services, New York. $1.60.

Calculations are made for three forward speeds corresponding to 352, 428, and 528 m.p.h. at 21,000 ft. over a range of mean incidence at each forward speed. The resultant tip Mach Number is 0.95. The plan form, number of blades, and blade section are the same as the propeller analyzed in *R. & M. No. 2021*, which in its original design was 14 ft. in diameter to absorb 2,000 hp. at 450 m.p.h. at 21,000 ft. In view of the importance of high power absorption at high altitude, the work is extended to the case of a four-bladed propeller absorbing 2,000 b.hp. at 37,000 ft. An improvement in efficiency of 0.015 was obtained by using the thickness-chord and solidity distribution of a good existing design. A note on the derivation of the Betz condition for minimum energy loss is given.

Interference Velocity for a Close Pair of Contra-Rotating Airscrews. C. N. H. Lock. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2084*, July 22, 1941. 15 pp., figs. 5 references. British Information Services, New York. $1.00.

The method developed for calculating the performance of a pair of counterrotating propellers is closely analogous to the strip theory method for a single propeller. The assumptions made are justifiable if the interference velocities are so small that their squares and products may be neglected. The equations are applied by an approximate single radius method to give the difference in blade setting between the two propellers for equal power input. The efficiencies of single and counterrotating propellers are compared. Calculations are not checked experimentally.

Propeller-Efficiency Charts for Light Airplanes. John L. Crigler and Robert E. Jaquis. *U.S., N.A.C.A., Technical Note No. 1338*, July, 1947. 44 pp., figs. 3 references.

Propeller efficiencies are given in terms of engine power, velocity, blade number, blade diameter, and propeller rotational speed. From these charts it is possible to evaluate the efficiencies obtained with high-solidity low-rotational-speed propellers compared with low-solidity high-rotational-speed propellers. The scope of the charts includes horsepowers from 50 to 300, air speeds from 50 to 200 m.p.h., propeller diameters of 6, 8, and 10 ft., and blade numbers of two, four, six, and eight. The charts permit the selection of the optimum propeller for given light-airplane design conditions and permissible propeller-noise levels.

Equations to Given Aerofoil Sections: "Clark Y" and RAF 6g. R. C. Pankhurst. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2130*, June, 1944. 6 pp., figs. 1 reference. British Information Services, New York. $0.55.

A Comparison of the Effects of Four-Blade Dual- and Single-Rotation Propellers on the Stability and Control Characteristics of a High-Powered Single-Engine Airplane. Charles W. Harper and Bradford H. Wick. *U.S., N.A.C.A., Advance Restricted Report No. 4F17 (Wartime Report No. A-43)*, June, 1944. 44 pp., illus. 1 reference.

Automatic Propeller Feathering System Developed Here for 2-0-2. *The Martin Star*, July, 1947, pp. 6, 7, 16, diagrs.

An automatic feathering system developed by The Glenn L. Martin Company. The failure of one engine of a two-engined aircraft causes the propeller of that engine to feather automatically and shut off its fuel supply. A torquemeter pressure of less than a specified value continuing for a predetermined period causes a time delay relay to actuate the electric propeller feathering system. When this system has operated, the feathering mechanism of the remaining propeller locks automatically.

Landmarks in Propeller Development. *De Havilland Gazette*, No. 39, June, 1947, p. 11, illus.

Radio and Electronics

Simplifying Airborne Radar. *Aviation Week*, Vol. 47, No. 5, August 4, 1947, pp. 33, 34, illus.

The Allison Radar and Equipment Co. is developing a 65-lb. anticollision, terrain-scanning radar unit that will incorporate all the operating mechanism required for the wartime APS-10 scope radar.

Decca System Navigation; A Lightweight Receiver Gives Instant, Accurate Fixes at Any Altitude in All Weather. C. S. Goode. *Canadian Aviation*, Vol. 20, No. 8, August, 1947, pp. 28, 29, illus.

Long-Range Radio Navigation Aids. II—Consol. *The Aeroplane*, Vol. 73, No. 1884, July 18, 1947, pp. 71–73, illus.

The Consol transmitter employs two antennas whose mutual interference produces a fanlike radiation pattern of segments that consist alternately of dots and dashes. A time lag is introduced between the two antennas in order to rotate the pattern. If a navigator knows the quadrant in which he is located, he can determine his position line accurately by counting the number of signals he hears as the segment sweeps past him. No specialized equipment on the aircraft is required other than a directional radio compass.

NACA Radio Ground-Speed System for Aircraft. Charles E. Hastings. *U.S., N.A.C.A., Advance Confidential Report (Wartime Report No. L-477)*, February, 1943. 30 pp., illus. 1 reference.

Investigation of the Feasibility of an Automatic Switch for Use with AN/APS-13 Forward Ranging. Paul W. Springer. *U.S., Army Air Forces, Technical Report No. 5404*, December 18, 1945. 7 pp., illus.

Theoretical Consideration of Ultra-High-Frequency Two-Course Simultaneous Radio Ranges. H. W. Kohler. *U.S., Civil Aeronautics Administration, Technical Development Note No. 44*, March, 1947. 33 pp., diagrs.

An Automatic Monitor System for Radio Ranges. J. M. Lee. *U.S., Civil Aeronautics Administration, Technical Development Report No. 51*, January, 1947. 54 pp., illus.

Development of the Ultra-High Frequency Radio Range. III—A Visual-Aural Ultra-High Frequency Radio Range with Simultaneous Voice. *U.S., Civil Aeronautics Administration, Technical Development Report No. 49*, June, 1945. 116 pp., illus.

Measurements of Noise Radiation from High-Voltage Transmission Lines. J. M. Lee. *U.S., Civil Aeronautics Administration, Technical Development Note No. 46*, May, 1947. 29 pp., diagrs.

An Investigation of Site Requirements for Very-High-Frequency Radio Ranges. J. M. Lee, B. M. Lahr, and R. R. G. Pamler. *U.S., Civil Aeronautics Administration, Technical Development Note No. 45*, April, 1947. 59 pp., illus.

Average Radio Ray Refraction in the Lower Atmosphere. M. Schulkin. *U.S., National Bureau of Standards, Central Radio Propagation Laboratory, Report No. CRPL-2-2*, August 11, 1947. 36 pp., figs.

Formula for the Manufacture of Selenium Mirrors and Investigation of Lead-Sulphide Compounds. Kutzcher. (*Kast und Ehinger GmbH*, February, 1945.) *U.S., Army Air Forces, Translation No. F-TS-1084-RE*, July, 1947. 22 pp., figs. 9 references.

Resonance Frequency of Tuning Forks. Kenzo Nagai and Mizuo Kimura. (*Tohoku, Imperial University*, June, 1943.) *U.S., Army Air Forces, Translation No. F-TS-708-RE*, July, 1947. 21 pp., illus.

Rotating Wing Aircraft

Stability of Rotor Blade Flapping Motion When the Hinges Are Tilted. Generalization of the "Rectangular Ripple" Method of Solution. Gabriel Horvay and S. W. Yuan. *Journal of the Aeronautical Sciences*, Vol. 14, No. 9, October, 1947, pp. 583–593, diagrs. 4 references.

An extension of the rectangular ripple method of solution (Meissner, VanderPol, Strutt) of certain differential equations to damped systems with both first and second harmonic fluctuations in the coefficients. The method is further extended to the determination of the flapping transient of a helicopter rotor blade. The stability problem of blade motion reduces essentially to the determination of two functions: the natural frequency of blade flapping and the apparent damping coefficient of blade flapping. Instability cannot occur unless the blade frequency is an integral multiple of half the rotor frequency and unless the apparent damping coefficient is less than zero. It is found that the flapping frequency in forward flight is prevalently 0f or $\delta_3 \lesssim -15°$, $^1/_{2\omega}$ for $\delta_3 \backsimeq 0°$, and ω for $\delta_3 \backsimeq 23°$. Yet, because of the large aerodynamic damping that a blade experiences during flapping, instability cannot set in except at unattainably large velocities of advance or at negative δ_3 of about 15° and over.

From Transport Plane to Autogiro. *Aviation Week*, Vol. 47, No. 11, September 15, 1947, p. 49, illus.

A device for in-flight conversion of a transport airplane to an autogiro, in order to achieve slow landing characteristics, has been patented by Antoine Gazda. In emergency, a two-bladed rotor, housed along the top of the fuselage, is raised up and autorotates to provide supplementary lift. Tests on a DC-3 are planned, after completion of experiments on a model B-36.

SO-1100 Undergoing Flight Tests. *American Helicopter*, Vol. 7, No. 9, August, 1947, p. 31.

The SO-1100 Giravion (or Ariel), now being flight tested by the Société National de Construction Aéronautique de Sud-Ouest of France, uses blade-tip jets to operate as a helicopter during take-off and hovering. When sufficient altitude has been gained a pusher propeller in the tail provides forward motion and the rotor autorotates.

The Kellett XR-10. G. F. Champlin. *American Helicopter*, Vol. 7, No. 9, August, 1947, p. 26, illus.

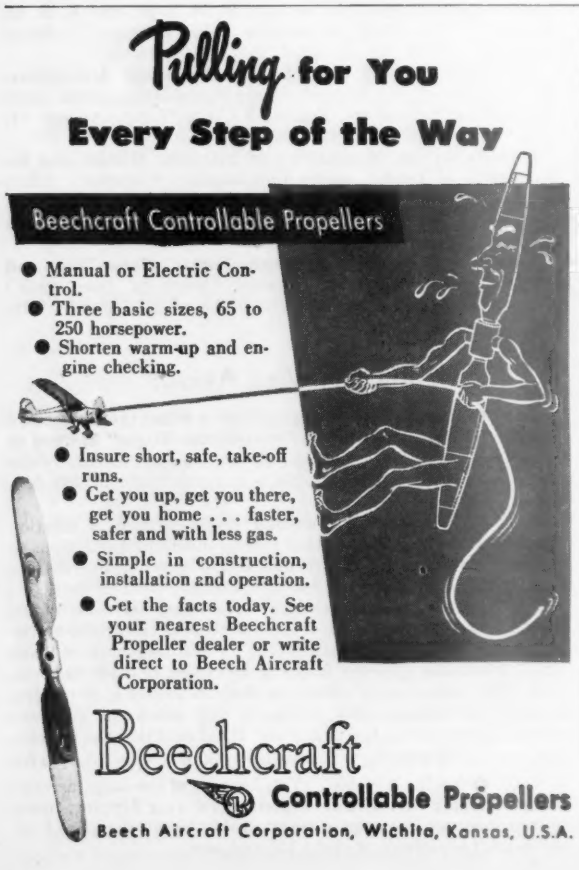
The 12-place transport helicopter Kellett XR-10 is powered by two 525-hp. Continental engines mounted in nacelles on either side of the fuselage. The two three-bladed, intermeshing, 65-ft. diameter, counterrotating rotors produce no torque, thus permitting the use of a three-fin tail of conventional design. Cruising speed is 90 m.p.h.; range, 350 miles.

First Canadian Helicopter Test Flown in Montreal (The Sznycer-Gottlieb Mark VI). *Canadian Aviation*, Vol. 20, No. 8, August, 1947, pp. 26, 27, 50, illus. (Cf. AER 3/47:81.)

The Seibel Helicopter. C. B. Francis. *American Helicopter*, Vol. 7, No. 9, August, 1947, p. 17, illus.

A model helicopter constructed by Charles M. Seibel of Wichita, Kan., eliminates both cyclic pitch and collective pitch mechanisms. Control is accomplished by shifting the center of gravity during flight. The forward portion of the fuselage is movable in relation to the rear part. The fore section is spring-loaded forward and restrained by a control cord. The amount of lift is varied by changing the rotor speed.

Notes from Helicopter School. III—More on Learning to Fly the Whirling Wing. Wolfgang Langewiesche. *Air Facts*, Vol. 10, No. 8, August, 1947, pp. 69–78, 80-82, diagrs.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Jet Rotors Point to 'Copter Payload Gain. *Aviation Week*, Vol. 47, No. 12, September 22, 1947, pp. 29, 31, illus.

Tests were made by the Marquardt Aircraft Corporation for the Air Materiel Command to obtain data on the effects of variations in r.p.m. on lift, fuel consumption, and angles of attack of a jet helicopter rotor. The hollow two-bladed, all-metal 21-ft. rotor receives a fuel-air mixture through the hub under a ram pressure. The fuel is further compressed by centrifugal force and is driven to the burners at the blade tips. The test rotor produces 1,000 lbs. of thrust at a tip speed of 600 ft. per sec. The data obtained indicate the possibility of increased pay load for flights of short duration.

Seaplanes and Flying Boats

Solutions for Hydrodynamic Impact Force and Response of a Two-Mass System with an Application to an Elastic Airframe. Wilbur L. Mayo. *U.S., N.A.C.A., Technical Note No. 1398*, August, 1947. 42 pp., figs. 4 references.

The bending of wings during impact is investigated by reducing the fundamental mode of the wing to an equivalent two-mass system. The impact of a rigid prismatic float connected by a massless spring to a rigid upper mass is solved by the use of hydrodynamic theory which has been confirmed experimentally for a rigid structure. The results, which are given in nondimensional coefficients, are compared with experimental results for a particular case. The equations showing the method of solution and a sample data sheet are given.

A Preliminary Correlation of the Behavior of Water Rudders on Seaplanes and Flying Boats. F. W. S. Locke, Jr. *U.S., N.A.C.A., Technical Note No. 1387*, August, 1947. 8 pp., diagrs. 3 references.

A rough correlation of the dimensions of water rudders of various actual seaplanes and flying boats with their behavior. The correlation should be useful for determining the size of a water rudder that will give adequate control for maneuvering at low speeds.

The Effect of Afterbody Length on the Hydrodynamic Stability of a Dynamic Model of a Flying Boat—Langley Tank Model 134. Norman S. Land. *U.S., N.A.C.A., Memorandum Report No. L5128a* (*Wartime Report No. L-684*), October, 1945. 12 pp., illus. 2 references.

General Free to Trim Tests in NACA Tank No. 2 of Three 1/8-Full-Size Models of Flying-Boat Hulls at Low Speeds—NACA Models 116E-3K, 120R, and 143. Arthur W. Carter. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. L-585*), January, 1943. 20 pp., diagrs. 1 reference.

Tank Tests of a 1/8 Full-Size Dynamically Similar Model of the Army OA-9 Amphibian with Motor-Driven Propellers, NACA Model 117. John B. Parkinson and Roland E. Olsen. *U.S., N.A.C.A., Advance Restricted Report* (*Wartime Report No. L-475*), December, 1941. 26 pp., illus. 2 references.

Tests of a 1/40-Scale Wing-Hull Model and a 1/10-Scale Float-Strut Model of the Hughes-Kaiser Cargo Airplane in the Two-Dimensional Low-Turbulence Pressure Tunnel. Felicien F. Fullmer, Jr. *U.S., N.A.C.A., Memorandum Report* (*Wartime Report No. L-633*), September, 1943. 19 pp., illus. 4 references.

General Tank Tests on the Hydrodynamic Characteristics of Four Flying-Boat Hull Models of Differing Length-Beam Ratio. Kenneth S. M. Davidson and F. W. S. Locke, Jr. *U.S., N.A.C.A., Advance Restricted Report No. 4F15* (*Wartime Report No. W-105*), June, 1944. 72 pp., illus. 12 references.

Stress Analysis and Structures

Computation of Influence Coefficients for Aircraft Structures with Discontinuities and Sweepback. Samuel Levy. *Journal of the Aeronautical Sciences*, Vol. 14, No. 9, October, 1947, pp. 547–560, diagrs. 17 references. (*See* AER 3/47:39.)

The Associated Matrices of Bending and Coupled Bending-Torsion Vibrations. Walter P. Targoff. *Journal of the Aeronautical Sciences*, Vol. 14, No. 9, October, 1947, pp. 579–582, diagrs. 5 references. (*See* AER 7/47:29.)

Instability Analysis and Design of an Efficiently Tapered Plate Under Compressive Loading. Samuel Pines and George Gerard. *Journal of the Aeronautical Sciences*, Vol. 14, No. 9, October, 1947, pp. 594–600, figs. (*See* AER 4/47:31.)

Interaction Between the Spars of Semimonocoque Wings with Cutouts. N. J. Hoff, Harry Kase, and Harold Liebowitz. *U.S., N.A.C.A., Technical Note No. 1324*, July, 1947. 49 pp., illus. 11 references.

The calculation of the interaction between the spars of an airplane wing that is not built according to the true monocoque principle is difficult if the rigorous methods of the theory of elasticity are used. The PIBAL method for the calculation of the stresses in reinforced flat and curved panels, rings, and frames, and in reinforced monocoque cylinders can take into account variable cross sections, stressed skin, and cutouts. The structure is assumed to be composed of several beam elements having bending, shearing, and torsional rigidity determined from the geometry of the wing structure and the mechanical properties of its materials of construction. The forces and moments corresponding to prescribed displacements of the end points of these elements are determined, and the conditions of equilibrium at these points are expressed in terms of the displacements. The result is a system of linear equations which is solved by matrix methods. The solution yields the displacements at the end points of the elements from which the stresses in any part of the structure can be easily calculated. The stresses in the two spars of a model wing with three rectangular cutouts were calculated and compared with data obtained under various conditions of loading and end fixation. The agreement was found to be satisfactory.

The Theory of Thin Plates Under Transverse Pressure. I—Thin Plating Under Transverse Pressure. A. G. Pugsley. **II—Some Comments on the Theory of Thin Plates Under Transverse Pressure.** D. M. A. Leggett. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2094*, August, 1941. 15 pp., figs. 10 references. British Information Services, New York. $0.60.

I. The behavior under pressure of thin plating such as is used in the metal covering of aircraft structures is examined under conditions in which the deflections are larger than the thickness. The importance of tensile actions in the plating as against bending actions is shown. By treating the plating as primarily an elastic membrane, a simple means of estimating both tensile and bending stresses is developed and applied to a series of examples to illustrate the effects of various parameters on the plating, such as initial curvature of the plating.

II. A review of the theoretical work on the behavior of long panels under transverse pressure which preceded that described in Part I. Where the displacements of the middle surface are small compared to the panel thickness, there is an exact and workable solution if both pairs of opposite edges are simply supported or if one pair is simply supported and the other pair is clamped. If both pairs of edges are clamped, an exact theoretical solution exists, but it is difficult to compute for long panels. For cases where the short edges are simply supported, a method devised by W. D. Douglas for fabric gives a good representation of the transverse reaction over the two long edges. For cases where the displacements of the middle surface are no longer small compared to the thickness of the panel, little theoretical work has hitherto been done.

Design Charts for Flat Compression Panels Having Longitudinal Extruded Y-Section Stiffeners and Comparison with Panels Having Formed Z-Section Stiffeners. Norris F. Dow and William A. Hickman. *U.S., N.A.C.A., Technical Note No. 1389*, August, 1947. 76 pp., illus. 6 references.

With these charts it is possible to design flat compression panels with longitudinal extruded Y-section stiffeners from 24S-T and 75S-T aluminum alloy. The panels will have the minimum weight required for a given load at a given effective panel length of given sheet thickness. Panels designed from these charts are compared with panels of designs employing Z-stiffeners.

Tables of Stiffness and Carry-Over Factor for Flat Rectangular Plates Under Compression. W. D. Kroll. *U.S., N.A.C.A., Advance Restricted Report No. 3K27 (Wartime Report No. L-398)*, November, 1943. 47 pp., tables. 5 references.

Experimental Investigation of the Post-Buckling Behaviour of Stiffened, Flat, Rectangular Plates Under Combined Shear and Compression. I. A. van der Neut, W. K. G. Floor, and I. Binkhorst. *Netherlands, Nationaal Luchtvaartlaboratorium, Amsterdam, Report No. S.300*, April, 1947. 103 pp., illus. 13 references.

The longitudinal edges of the panels, which have a length to width ratio of 3 to 16, were approximately simply supported. The stiffness against the compression of the longitudinal stiffness, the ratio of external (lateral) compression and shear, and the ratio of the load to the buckling load were varied. The longitudinal and lateral strains, the shearing strain, and the longitudinal stiffener loads were measured. The shape of the buckled plate was determined by profile and slope recordings. The stress distribution in the plate was computed from the recordings. The tabulated and charted results are evaluated by introducing wave form ratios that indicate the degree of development of the tension field as compared with the completely developed tension field. Based on the test results reported, a preliminary proposal is made for the calculation of the behavior of initially flat, stiffened, rectangular plates.

Critical Compressive Stress for Curved Sheet Supported Along All Edges and Elastically Restrained Against Rotation Along the Unloaded Edges. Elbridge Z. Stowell. *U.S., N.A.C.A., Restricted Bulletin No. 3107 (Wartime Report No. L-691)*, September, 1943. 11 pp., diagr. 5 references.

A Principal Stress Method of Stress Analysis. H. B. Maris. *The Franklin Institute, Journal*, Vol. 244, No. 1, July, 1947, pp. 27–62, figs. 5 references.

Lamé's equations of equilibrium in a stress field are compared with those of Cauchy. The ($P - Q$ and $P - R$) terms of the Lamé equation, which are identified by the new words "detend" and "double detend," are invariants for any point in the stress field. The principal stresses are defined as real stress components. The terms of Cauchy's expression for force equilibium in a stressed body are defined as imaginary components of force per unit area. Shear is found to be an imaginary component of force parallel to a plane. The photoelastic equidetend (isochromatic) and isoclinic maps of a plane stress field define, for any point, a gradient triangle with three maximum gradients for its sides. Five equations that define elements of the gradient triangle in terms of five measurable quantities are developed. Graphic integration of principal stress changes along any line in a stress field can be made by plotting the line straight and measuring the area swept out by the normal projections, along the line, of the sides of the gradient triangle after it has been rotated through 90°.

The Bending Strength of Materials with a Non-Linear Stress-Strain Curve. S. S. Gill. *Aircraft Engineering*, Vol. 19, No. 221, July, 1947, pp. 212–216, figs. 4 references.

A method of deriving expressions for the position of the neutral axis and the failing moment of resistance of structural sections made of materials for which the stress-strain curve is nonlinear and is different in tension and compression. Sections considered are symmetrical and unsymmetrical I-sections and channel sections, angles, solid circular sections, and thick and thin tubes. Curves are given from which the axis and moment of tubular and solid circular sections of any material may be found when the stress-strain characteristics in tension and compression of the materials are known. The curves given for I-sections, channel sections, and angles apply only to the material DTD.289. The use of this method in designing a section will give only the failing moment of resistance. Proof of load requirements must be considered independently.

Relations Between the Elastic Constants. D. S. McGregor. *Engineering*, Vol. 164, No. 4252, July 25, 1947, p. 76, fig.

A simple construction for deriving the relation between the modulus of elasticity, the modulus of rigidity, and Poisson's ratio. The premise is used that equal complementary shear stresses exist on planes at right angles and that, on planes at 45° to the pure shear planes, there are mutually perpendicular pure tensile and compressive stresses each of magnitude equal to the pure shear stress. This method avoids the difficulty caused by the approximation used in the conventional method of deriving these relationships.

Approximate Formulae for Beam-Columns. R. O. Whiting. *Engineering*, Vol. 164, No. 4250, July 11, 1947, pp. 25, 26, figs.

The deflection of a strut having initial curvature under an axial load is almost equal to the original deflection multiplied by a factor containing only the load and Euler's formula. This approximation is developed into a simple correlated series of expressions for cases of simple loading which admit of graphical solution. The same approximation may also be used as a simple solution of the problem of the continuous beam.

Numerical Transformation Procedures in Continuous Beam Analysis. Stanley U. Benscoter. *The Franklin Institute, Journal*, Vol. 244, No. 1, July, 1947, pp. 15–26, diagrs.

Several new types of numerical procedures are presented for the calculation of bending moments in continuous beams. The well-known basic physical properties of the beam and its loading which are employed are defined. They may be calculated conveniently by means of a conjugate beam. The procedures resemble the process of moment distribution. The validity of the procedures are demonstrated mathematically.

Bending and Shear Stresses Developed by the Instantaneous Arrest of the Root of a Cantilever Beam with a Mass at Its Tip. Elbridge Z. Stowell, Edward B. Schwartz, John C. Houbolt, and Albert K. Schmieder. *U.S., N.A.C.A., Memorandum Report No. L4K30* (*Wartime Report No. L-586*), November, 1944. 31 pp., illus. 1 reference.

Shear-Lag Tests of Two Box Beams with Corrugated Covers Loaded to Failure. Patrick T. Chiarito. *U.S., N.A.C.A., Advance Restricted Report No. 4A05* (*Wartime Report No. L-482*), January, 1944. 17 pp., illus. 5 references.

Charts for Calculation of the Critical Stress for Local Instability of Columns with I-, Z-, Channel, and Rectangular-Tube Section. W. D. Kroll, Gordon P. Fisher, and George J. Heimerl. *U.S., N.A.C.A., Advance Restricted Report 3K04* (*Wartime Report No. L-429*), November, 1943. 28 pp., figs. 6 references.

Transverse Vibrations of Bars and Fatigue Structures. II. P. Matthieu. (*Schweizer Archiv*, Vol. 12, Nos. 11–12, November-December, 1946, pp. 329–338 and 361–372.) *Engineers' Digest*, Vol. 4, No. 7, July, 1947, pp. 330–334, illus.

The wave form and the stress function can be represented as linear combinations of exponential and oscillating functions. A comparison of these functions proves that, in the case of a bar fixed at one end and subjected to vibrations caused by a shock, the point of highest stress is the point of fixture if the shear forces of the natural harmonic vibrations are small. If the shear forces are large, as is the case with the higher harmonics of the natural vibration, the greatest stress occurs near the free end. In the case of a tapered bar, fracture would most probably occur near the free end for any free vibration. Only if the lowest harmonic predominates strongly over all higher harmonics will the bar fracture occur at the point of fixture. Confirming tests were made on sample bars, steam turbine blades, and propeller blade models.

Effect of Variables in Welding Technique on the Strength of Direct-Current Metal-Arc-Welded Joints in Aircraft Steel. I—Static Tension and Bending Fatigue Tests of Joints in SAE 4130 Steel Sheet. C. B. Voldrich and E. T. Armstrong. *U.S., N.A.C.A., Technical Note No. 1261*, July, 1947. 52 pp., illus. 1 reference.

Arc-welded butt joints in $^1/_8$-in. SAE 4130 steel sheet, which were made under various welding and heat-treatment conditions, were tested to evaluate the effects of specific welding-technique factors on the strength of the joints. The results of the tensile tests indicated that crater blowholes, or crater cracks, produced by interrupting the weld, had the greatest influence on the transverse tensile strength of the butt-welded specimens; that position of welding had no significant effect on the tensile strength of any group of specimens; and that welds made with alloy-steel electrodes were stronger than those made with plain carbon-steel electrodes. The factor having the greatest influence on the plate-bending fatigue strength of the welded specimens was the external stress-raiser at the toe of the welds in the reinforced specimens.

Brittle Lacquer Stress Analysis. II. E. Barber. *Engineering Materials*, Vol. 5, No. 18, August, 1947, pp. 87–89.

Performance Tests of Wire Strain Gages. V—Error in Indicated Bending Strains in Thin Sheet Metal Due to Thickness and Rigidity of Gage. W. R. Campbell and A. F. Medbery. *U.S., N.A.C.A., Technical Note No. 1318*, July, 1947. 11 pp., illus. 4 references.

The Automatic Sonigage. Wesley S. Erwin and Gerald M. Rassweiler. *The Iron Age*, Vol. 160, No. 4, July 24, 1947, pp. 48–55, illus.

An instrument for measuring thickness when only one surface is accessible, with less than 2 per cent error. A quartz crystal applies ultrasonic frequencies to the specimen. The induced fundamental and harmonic resonant frequencies are read from the deflection of the trace of a cathode-ray scope that is calibrated to be read directly in thickness. A tuning condenser rotates continuously to sweep the frequency of the oscillator through its tuning range. Flaws in flat parts, between 0.005 and 0.250 in. thick, and in certain types of defective bonding can be detected.

Operating and Service Manual for the TMB Type 1A Strain Indicator. W. S. Campbell. *U.S., David Taylor Model Basin, Report No. R-351*, July, 1947. 34 pp., diagrs.

The range, response, and general performance of a carrier-type strain indicator developed by the David Taylor Model Basin for the measurement of static and dynamic strains. Installation and operating instructions, circuit-adjustment procedure, and circuit diagrams of the unit and its power supply are given. Strains varying in frequency from zero to 200 cycles per sec. can be accurately measured.

Electronic Measuring Equipment for Aeronautical Research. *The Engineer*, Vol. 184, No. 4774, July 25, 1947, pp. 85, 87.

Brief descriptions of the pickups, multichannel recording equipment, four-way cathode-ray oscilloscopes, and 600-way static strain recording equipment, torquemeters, transmitting accelerometers, and statistical accelerometers exhibited by the Royal Aircraft Establishment.

Electronics and Aeronautical Research. *Engineering*, Vol. 164, No. 4252, July 25, 1947, p. 91. (Cf. preceding abstract.)

Wind Tunnels and Laboratories

The Effects of Compressibility on the Two-Dimensional Subsonic Wind-Tunnel Constriction Correction. H. T. Epstein and L. U. Albers. *University of Michigan.* (For abstract see "I.A.S. Briefs" on page 18 of this issue, November, 1947.)

Drag Correction in High-Speed Wind Tunnels. H. Ludwieg. (*Göttingen, ZWB/FB/1955*, April 14, 1944.) *U.S., N.A.C.A., Technical Memorandum No. 1163*, July, 1947. 33 pp., figs. 7 references.

In a wind tunnel, drag of a body produces a region of still air behind it which deflects the flow laterally. Because of the boundary conditions, this gives rise to an additional flow at the boundary of the stream. While this additional flow does not produce a velocity component at the model in the closed tunnel, it does evoke an additional velocity at an infinite distance upstream from the model, which produces a pressure gradient ahead of the model. Since the model is in this pressure gradient, it experiences an additional drag. The correction necessary to compensate for this change of drag is calculated for compressible flow. It is found that the factor diminishes with increasing Mach Number because the additional drag due to the pressure gradient of the wake is a pure potential drag that is not associated with any loss of flow and, therefore, is not noticeable in the wake.

Note on Wind-Tunnel Contractions. F. Cheers. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda, No. 2137*, March, 1945. 7 pp., figs. 4 references. British Information Services, New York. $0.55.

A mathematical method of designing contracting channels of wind tunnels in two dimensions with favorable pressure gradient along the entire length. The method is proposed as a guide for three-dimensional work. Comparisons are made with contraction cones in three dimensions and with diffusers in two and three dimensions, which are designed by similar methods in order that they may have a single discontinuity in the velocity at the surface. Comparison indicates that the change of shape resulting from the present design is generally advantageous in that it gives a long low-speed region with small velocity variation, suitable for use as a settling length and a short high-speed section, which will cut down losses.

On the Use of Jet Drives for Wind Tunnels of High Velocity. H. Winter. (*Göttingen, Aerodynamische Versuchsanstalt, Forschungsbericht Nr. 1103*, October 7, 1947.) *U.S., David Taylor Model Basin, Translation No. 219*, April, 1947. 25 pp., diagrs. 5 references.

In one type of high-speed intermittent wind tunnel, motion is imparted to the air mass which passes through the test section by a jet of compressed air or steam. The nozzle is arranged so that the jet picks up atmospheric air and induces the flow in the test section. The variation in the ratio between the jet mass and the induced air mass caused by changes in pressure at the jet source and the overall efficiency of this type of tunnel is calculated. The experiments and calculations showed this design to be practicable if a closed test section is used. At sonic velocity, variations in pressure at the jet source have little or no effect on the velocity of the air mass in the test section.

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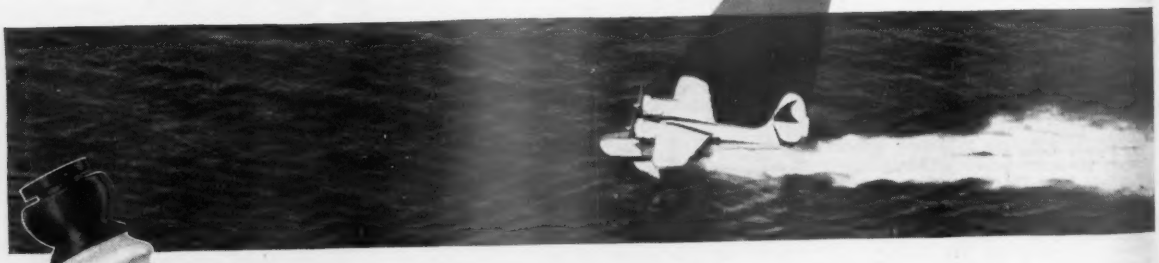

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Books

Airplane Design. Karl D. Wood. 8th Ed., September, 1947. Boulder, Colo., University of Colorado Bookstore, 1947. 356 pp., illus., diagrs., figs. $6.00.

The outstanding feature of the eighth edition of this well-known college text on the design of aircraft is its timeliness in presenting hitherto confidential technical data of the N.A.C.A. and other Government sources together with examples illustrating their use. An appraisal of the volume will reveal the great value of the new material presented and lead the reader to be lenient with regard to certain imperfections and the incompleteness of revisions. It is reported that, in order to present the material at the earliest possible date, the printing was speeded to such an extent that a photolithographed text was available 16 days after delivery of the manuscript to the printer. Incorporated in the book are data on the new low-drag airfoils, examples illustrating the principles of layout of jet-propelled aircraft including supersonic jet aircraft, and many other developments of World War II.

The author's primary objectives have been to show the student how to design aircraft and to provide him with the data necessary to carry a design project through its preliminary stages. Because aircraft components are in a state of continuous development, frequent revisions in a book of this kind are necessary. However, from 1943 to 1947, military secrecy shrouded those developments important to an appraisal of the components of the aircraft of the future. The release of thousands of formerly classified documents in the spring of 1947 has enabled the author to discuss publicly, with substantiating data, the trends in airplane design which may be expected in the near future.

The book provides the student with the occasion of applying the fundamentals of fluid mechanics, thermodynamics, aerodynamics, and strength of materials to a design problem of importance. Emphasis is placed on the economics of design. Information is given about the layout design of light airplanes, transport and cargo planes, flying boats, high-speed airplanes, and helicopters; structural design considerations; production methods and costs as factors in design; and the design of the wing, control surfaces, landing gear, the fuselage, and hull.

All of the books reviewed and listed are in the I.A.S. Library and may be borrowed without charge, except for certain reference books. Application for loans should be made to The Paul Kollsman Lending Library, 2 East 64th Street, New York 21, N.Y.

The appendix contains data on the properties of air and airflow; aerodynamic, hydrodynamic, power-plant, weight, structural design, and cost data; and data for passenger accommodations and comfort.

Wind-Tunnel Testing. Alan Pope. New York, John Wiley and Sons, Inc., 1947. 319 pp., illus., diagrs., figs. $5.00.

While the major part of this book is devoted to wind-tunnel testing, a large amount of information is given about wind-tunnel design, although this material is confined to the design of the general utility tunnel and small wind tunnels. The author is Associate Professor of Aeronautical Engineering at the Daniel Guggenheim School of Aeronautical Engineering, Georgia School of Technology. The work is based on an extensive analysis and study of the scattered but vast amount of material on wind-tunnel testing, a subject of growing importance. This importance is emphasized by a table in which are listed some 119 wind tunnels located in various countries throughout the world. The list includes the many new high-speed and supersonic tunnels under construction by the N.A.C.A. The volume has been written to meet the need for an integrated work embracing design, procedures, and corrections to applied wind-tunnel data, and it should be a valuable aid to those requiring a reference book for such work. The problem of wind-tunnel testing and procedure for testing a new type of airplane are discussed in detail.

The introductory chapter provides the reader with a general understanding of the various types of wind tunnels and the principles on which they operate. The design requirements for a general utility tunnel are then discussed, after which consideration is given to the calculation of the wind-tunnel jet. Following chapters deal with load measurements of the model to obtain data on the forces, moments, and pressures; testing procedure; wind-tunnel boundary corrections; extrapolation to full scale; auxiliary equipment; and small wind tunnels. The construction of the wind-tunnel model is outlined in an appendix, and there are convenient tables of numerical constants and conversion factors.

Illustrated Jig-Tooling Dictionary. Torger G. Thompson and Ross A. Peterson. New York, The Macmillan Co., 1947. 349 pp., illus., tables. $7.50.

Those who are engaged in tool and jig construction will find the wealth of illustrated data supplied in this directory invaluable. The authors have chosen a method of presentation which is both convenient and instructive. Functional drawings accompanied by clear-cut explanatory legends provide information about all the common and many of the special types of tooling procedures. The basic equipment of the tool engineer and the actual use of this equipment is thus graphically demonstrated.

Over 1,000 terms referring to tools, parts, and operations are covered. In addition, many allied terms commonly used in connection with tooling are included, such as mathematical procedures; formulas; the properties and treatment of metals; standards and basic dimensions; and terms used in connection with plastic forming processes, welding, and technical drawings and blueprints. Also covered is special terminology in individual industries, including aircraft manufacturing. Walter F. Theis, Superintendent of Tooling of the Texas Division of North American Aviation, Inc., supplied suggestions and assistance in the preparation of the book.

Attention is given to the latest precision equipment of the trade. Typical tooling procedures are illustrated by series of drawings. It is stated that all the data has been taken from the design and construction of tools, jigs, and fixtures in use in modern industry.

The illustrations are good and there are convenient cross references. An appendix contains tables of data useful in tooling work.

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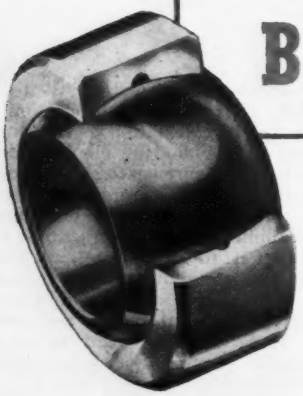

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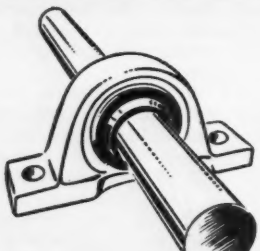

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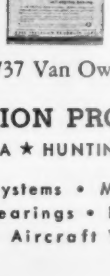

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Aircraft Sheet Metal. Rollen H. Drake. New York, The Macmillan Co., 1947. 233 pp., illus., diagrs. $5.50.

This text, which is one of "Drake's Aircraft Mechanic Series," discusses all the important phases of aircraft sheet-metal work in an unusually thorough manner and with a clarity of language which will be appreciated by those seeking the information and instruction needed to fulfill the requirements of an aircraft mechanic's license. It is suitable either as a class text in vocational courses, aviation ground schools, and trade schools, or as a mechanics' handbook. There is detailed information about the identification and uses of the metals and alloys commonly employed in aircraft fabrication, the theory underlying the fabrication of sheet metal, and the treatment before and after fabrication. Each of the various methods of forming and fastening sheet metal is explained in detail, with emphasis not only on correct procedures but also on the detection of faulty workmanship and flaws. The making of repairs is discussed with stress on the types of approved repairs required by the C.A.A. It is stated that all the procedures have been thoroughly checked for accuracy and completeness by the foreman of the TWA overhaul shop, and that leading aircraft and metal working companies have contributed up-to-date practical information on methods and materials.

Following the introduction there is a chapter outlining the general properties of metals in a manner that will enable the reader to grasp the elements of the subject with a minimum amount of effort. In subsequent chapters details are given about aluminum, magnesium, and iron and their alloys. The identification and fabrication of the sheet metals used in aircraft are then discussed. There are chapters on heat-treatment, tools and machinery, technical drawings, layout, forming, machine tool operations, assembly, and many other phases of the work. A glossary of terms used in sheet-metal work is included.

Aircraft Welding. Rollen H. Drake. New York, The Macmillan Co., 1947. 254 pp., illus., diagrs. $4.00.

Following the clear and concise method of presentation used by the author in his book, *Aircraft Sheet Metal*, this text provides the welding instruction required by those who are studying to obtain an aircraft mechanic's license. Because it contains detailed information about almost every phase of welding, those already engaged in welding work will find the book useful as a reference. The volume, another of "Drake's Aircraft Mechanic Series," explains in simple language the theory underlying the production of a successful weld, the properties and characteristics of the different metals, and the particular uses of each main type and its reaction to heat-treatment. The different

types of welding used on aircraft are described, and there is step-by-step instruction on the construction of welded rudders, stabilizers, engine mounts, and other welded parts. The reader is told how to set up and operate welding equipment, and given thorough instruction on the making of approved welded joints. Illustrations aid in an understanding of the subject. Emphasis is placed on methods of detecting flaws and faulty welds. Chapters on matters related to welding, such as technical drawings for welds, safety practices, and the vocabulary of welding, are included. The materials, tools, and techniques described in the text are illustrated with good detailed drawings and photographs.

The Analysis and Synthesis of Linear Servomechanisms. Albert C. Hall. Cambridge, Mass., The Technology Press, Massachusetts Institute of Technology, 1947. 193 pp., diagrs., figs. $2.50.

The present work, which forms an excellent basic text on the analysis and design of linear automatic control systems, was originally submitted to the Massachusetts Institute of Technology as a doctorate thesis several years ago and was first issued as a "restricted" publication in 1943. It has only recently been declassified. The theory set forth has been tested and proved in application to many problems at the Servomechanisms Laboratory at M.I.T., where much of the investigation that resulted in this book was carried on. Servomechanisms have important applications in the automatic steering and control of aircraft, missiles, and ships; the regulation of speeds, temperature, pressure, and liquid levels; the control of military and naval devices; and in the control of numerous industrial processes. This presentation of the theory should be of value to all engineers who are concerned with the preceding applications or with others in which accurate automatic control is needed. The work is important also in that much of the published literature on the subject deals with design features and specific applications rather than with general principles.

After a short introduction on methods of analysis, chapters on servomechanism fundamentals, minimum integral-squared-error, and the fundamental properties of servomechanism transfer-function follow. In the next chapter, which is devoted to the application of transfer-loci to the adjustment of servomechanisms, important factors are discussed and the case of a servomechanism with third-order transfer-function is taken up. The theory of minimum velocity-error servomechanisms is divided into two parts and treated in Chapters V and VIII. Chapters VI and VII explain the theory of phase-lead-controllers and set up approximation criteria. Basic controller networks, regenerative controllers, and constant-resistance controllers form the subjects of the three final chapters. Suggestions for further work in compensation by means of paralleled devices, in the design of sense-detecting rectifiers, and in the design of carrier-frequency compensating devices are made in a brief appendix. A selected bibliography is also appended. In this second printing, the transfer-loci have been redrawn and made more legible by improved reproduction. Although the theory has been developed mathematically for electrical networks, it is applicable also to mechanical, hydraulic, and other types of linear devices.

Mechanik. Band I., Statik der Starren, Flüssigen und Elastischen Körper (Mechanics. Vol. I, The Statics of Rigid, Fluid, and Elastic Bodies). Ernst Meissner and Hans Ziegler. Basel, Verlag Birkhäuser, 1946. 340 pp., figs. Sw. fr. 36. (In German.)

This college text has been developed from German-language lectures delivered to students of engineering, mathematics, and physics at the Eidgenössische Technische Hochschule in Zurich. The book is intended to be not only a fundamental treatment of the statics of rigid bodies, hydrodynamics, and elementary strength of materials, but also an introduction to the methodology used in mechanics. A basis and background is provided for more advanced studies in kinematics, the kinetics of rigid bodies, the kinetics of systems and flows, and elasticity. These last-named subjects will be dealt with in two subsequent volumes. The theoretical aspect of the subject is developed in such a fashion as to give students a solid foundation in the most important branches of mechanics. Since mechanics is a practical science, an attempt has also been made to do justice to the practical aspects. A knowledge of college mathematics on the part of the student is presupposed. The authors have been careful to introduce the more difficult and complex computations step by step, as they arise in the development of the topics, and only after simpler manipulations have been amply demonstrated.

Rotary Valve Engines. Marcus C. Inman Hunter. London, Hutchinson's Scientific and Technical Publications, 1947. 216 pp., illus., diagrs. 21*s*.

Throughout the history of the internal-combustion engine, many attempts have been made to utilize the greater mechanical simplicity and economy factors of the rotary valve in actual designs. In most cases, after a period of initial enthusiasm, the designs were dropped and investigations ceased, some because of inherent deficiencies in design and others because of financial or commercial setbacks. Recent applications which have shown more success in the aeronautical field are to be found in the British Hercules, the Napier Sabre 24-cylinder engine, and the Rotol P6 auxiliary generating plant for aircraft. All of these employ semirotary sleeve valves. Another example is the Cross 150-hp. light aircraft engine with its cylindrical valves.

In preparing this first textbook devoted entirely to the principles and design of rotary-valve engines, the author has kept in mind the practical needs of the engineer. Following the theoretical treatment and the statement of specific problems, more than 20 engines of historical importance are described and analyzed in detail. Factors such as bearings and friction, lubrication and sealing, thermal expansion and contraction, cooling, compression ratio, ignition, and strength and cost of materials are considered for the examples, as well as in the general discussions in the theoretical sections. It is evident that much searching of the literature and company files must have been necessary in gathering the historical material, particularly in discovering the actual reasons for the abandonment of certain models. Information about rotary-valve steam and Diesel engines is included. The book is well organized and contains more than 100 clear and carefully drawn diagrams. There are about 20 footnote references and a brief index.

Contents: Historical Foreword; Valve Definitions and Principles of Design; Port Areas and Valve Diameters for Four-Cycle Engines; Drive Gear and General Application of the Rotary Valve to the Engine; Early Examples of Rotary Valves; Burt McCollum Semi-Rotary Sleeve-Valve Engine; Modern Rotary-Valve Systems; The Rotol Auxiliary Generating Plant for Aircraft; German Disk-Valve Engines; Claims for the Rotary Valve, Future Trend and Reflection; Author's Conjectures.

Rolling Bearings. 2nd Ed. R. K. Allen. London, Sir Isaac Pitman & Sons, Ltd., 1946. 401 pp., illus., diagrs. 30*s*.

The author has titled this comprehensive treatise "Rolling Bearings" because he considers the expression "ball and roller bearings" too cumbersome and the term "antifriction bearings" inaccurate since some other types of bearings may possess antifriction properties. Since, in engineering practice, the term "antifriction bearings" is generally recognized as referring to ball and roller bearings in particular, his choice is of academic rather than practical significance. Of real importance is the fact that this book fills a gap in the range of engineering texts, for, as is pointed out in the preface, the technical literature in English on the subject of ball and roller load-carrying elements, with the exception of one handbook now out of print, has been confined to occasional authentic papers in the transactions of engineering institutions and societies, articles in the technical press, and trade publications issued by bearing manufacturers. While such special

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information is of unquestionable value, it is fragmentary in nature, restricted in scope, and lacks coherence. The author's aim has been to provide a book containing the basic data required by those whose business it is to make efficient use of bearings constructed on the rolling principle. The task of accomplishing this within the limits of 400 pages is no easy one, but an examination of the text reveals results that are commendable. The first four chapters of the volume deal with the history of rolling bearings, design fundamentals, the relative movement of rolling parts, and bearing materials and manufacture. Formulas based on the work of Hertz and Stribeck are given in Chapter V, and these are analyzed in Chapter VI and their application to typical bearings shown. Palmgren's endurance formula in relation to the work of Hertz and Stribeck is discussed in Chapter VII. Other chapters are devoted to typical and unusual bearings; dimensional standards; bearing selection and application; lubricants and lubrications; limits and fits; fitting, maintenance, and repairs; and performance in service. An extensive bibliography is included.

Jane's All the World's Aircraft, 1947. Compiled and Edited by Leonard Bridgman. 35th Year of Issue (Issued August, 1947). London, Sampson Low, Marston & Co., Ltd., 1947. 447 pp., illus, diagrs.

This latest edition of *Jane's All the World's Aircraft* has been completely revised, and 87 per cent of the 630 illustrations presented are new. As in the past, the largest part of the book is devoted to particulars about aircraft and aircraft engines, but the historical section is continued. Because of the rather unstable condition of present-day civil aviation, the portion of the historical section dealing with this subject has been limited to essential reference data concerning the organizational background of civil aviation in the different countries of the world. Government organizations and establishments, associations, scheduled airline operating companies, flying clubs, airports, etc., are detailed, but the reader may be disappointed to find no list of air routes. With the large reduction in the strength and activity of the air forces of the Allied nations, the section on service aviation has been returned to prewar form with standardized information concerning those countries that support an organized air arm. Because the lessons learned during World War II still are being assimilated and plans for reorganization and re-equipment have yet to be disclosed, this section probably provides the best picture of the current state of the world's air forces that it is possible to present under the conditions.

Germany and Japan are absent in the section on airplanes, but there is an increase in the number of pages devoted to nearly every country manufacturing aircraft. Information is supplied about many new types of civil aircraft. The relaxation of security has permitted the inclusion of a great deal of new information about military aircraft and also has made it possible to present in the aircraft-engine section more data on jet engines of British and American origin. The excellent practice of giving metric as well as English measurements in the majority of the statistics is continued.

Other Books Received

AERODYNAMICS

Osborne Reynolds and His Work in Hydraulics and Hydrodynamics. A. H. Gibson. London, Published for The British Council by Longmans, Green and Co., 1946. 33 pp., illus., maps. 1s. 6d. A review of the research work and physical investigations carried out by this outstanding engineer-physicist during the latter half of the nineteenth century. It describes not only his famous work in the field of hydraulics and hydrodynamics but also his contributions to other branches of physics and engineering. A list of his original papers is included.

AIR TRANSPORT

Air Transportation. Report of Subcommittee on Air Transport of the Railroad Committee for the Study of Transportation. Washington, Association of American Railroads, 1947. 127 pp., illus., tables. Virtually every phase of air transportation is reviewed in this comprehensive report, but special attention is given to air carriers that have been granted certificates of public convenience and necessity by the Civil Aeronautics Board. Of particular value is the large amount of statistical data presented. The first chapters outline the development of domestic and international operations and the technical progress that has been made in the air transport industry. Detailed consideration is given to the transportation of passengers by air, air mail, air freight, airline equipment, air-line operating costs, and questions of taxation. A careful study is made of private flying and matters relating to the provision, financing, and administration of airports. Other chapters consider the character and extent of public aids to air operations and state and federal legislation. The concluding chapter surveys the outlook for air transportation. The report is the work of a subcommittee made up of railway men with specialized knowledge and experience in the fields covered. The report should be of value to those who require comprehensive and up-to-date information about the air transport industry to guide them in the consideration of questions affecting its future role in the transportation field.

National Air Cargo Survey. N. W. Kendall and James C. Nelson. (Industry Report, Domestic Transportation, June–July, 1947.) U.S., Bureau of Foreign and Domestic Commerce, Washington, 1947. 101 pp., tables. In this report the treatment of air-carrier developments is largely confined to the noncertificated air-cargo carriers. Statistical information reveals not only the benefits and particular advantages that can be obtained from the use of air-cargo services but also some of the inadequacies of the services.

ICAO Regional Manual: North Atlantic. (Document No. 4500, May 15, 1947.) Montreal, International Civil Aviation Organization, 1947. 260 pp., tables, maps. $10.00.

Information for pilots and air-transport operators on regional procedures and radio facilities, with a directory of international airdromes and instrument approach and landing charts. The concluding section contains a table of scheduled air lines, a list of international customs and regulations, airdromes available to civil aircraft, and conversion tables.

AIRPLANE DESCRIPTIONS

Aircraft of the United States. Vol. II. R. A. Saville-Sneath. Harmondsworth, Middlesex, England, Penguin Books, 1946. 256 pp., illus. A useful reference book giving brief descriptions and principal specifications of aircraft produced in the United States from 1936 to 1946. The material is arranged under the following headings: biplane landplanes, monoplane seaplanes and amphibians, biplane seaplanes and amphibians, monoplane gliders, gyroplanes and helicopters, jet aircraft, and airships. Also included are particulars about aircraft engines, an index of aircraft names and structural features, and an index of aircraft manufacturers.

AIRPLANE DESIGN

Les Avions Modernes (Modern Airplanes). Vol. II. Henry Lanoy. Paris, Girardot et Cie., 1947. 328 pp., diagrs. 324 fr. The theory of aircraft engines is reviewed, followed by a section on types of existing internal combustion engines, carburetion, supercharging, lubrication, cooling, and installation. A final chapter deals with reaction motors and gas turbines. The first 41 pages deal with the characteristics of various recent airplanes and gliders, with a brief discussion of airplane assembly and maintenance. Intended for mechanics and as an introductory work for further study, the book is well illustrated with drawings and photographs.

AIRPORTS

The Airport Directory. 12th Annual Ed. New York, The Haire Publishing Co., 1947. 256 pp., maps. $3.00. The latest edition of a directory of airports and their facilities, listed by states. Also included are directories of aircraft manufacturers, aircraft distributors, certificated air lines, government agencies, a list of radio stations, a classified directory of products and their manufacturers, and other useful information.

DRAFTING

Drafting Manual. Santa Monica, Calif., Douglas Aircraft Co., Inc., 1946. 197 pp., diagrs. A compilation of selections from various engineering manuals describing Douglas drafting practices and engineering procedures. Revisions will be made annually.

FLIGHT TECHNIQUE

Safe for Solo. Frederick M. Reeder. New York, Harper & Brothers. 216 pp., illus. $3.75. A readable book on elementary flight instruction prepared by two men with long experience in this field. Rear Adm. Frederick M. Reeder, U.S.N. (Ret.), who wrote the text, was in charge of the U.S. Navy's Flight Instruction School. The illustrator, Robert C. Osborn, is the originator of the famous Dilbert cartoons that were used with success by the Navy in pointing out to personnel many common and avoidable errors in flying and handling airplanes. It explains, in simple, logical terms and with the aid of humorous cartoons, what the beginner should know about flying.

GAS TURBINES

Gas Turbines and Jet Propulsion. (Letter Circular No. LC 872.) Washington, U.S., National Bureau of Standards, 1947. 52 pp., chart. A bibliography of published sources of information about gas turbines and jet propulsion. The first section lists books published from 1910 to 1947 and comprises 28 titles on gas turbines and jet power plants and 16 titles on atomic energy. The second section contains 585 titles selected from periodicals published between January, 1940, and July, 1947. These references deal with the theory, design, compounding, and application of gas turbines, ram jets, and rockets; atomic

energy; and the thermal properties of gases. As an aid to the reader, a brief discussion of terms and fields of application is included. Recent power plants are classified, and the rating of jet engines is explained.

GLIDING AND SOARING

Gliding and Advanced Soaring. A. C. Douglas. London, John Murray, 1947. 318 pp., illus., diagrs. 16s. Written without abstruse technicalities and illustrated with explanatory diagrams and photographs, this book describes the advances in the art and science of gliding and soaring. Particulars are given about training in all its stages, sailplane design and construction, meteorology and advanced soaring, and club operation. The book has been written especially for those who wish to take up the sport of gliding and soaring. It contains information about cross-country flying; altitude flying; some geological influences; sailplanes that have been built; the making of repairs; instruments, releases, trailers, and retrieving cars; and some well-known hill sites. Included in an appendix are specifications of gliders and sailplanes of British design.

HELICOPTERS

Proceedings of the Third Annual Forum, Philadelphia, March 27, 28, 29, 1947. Bridgeport, Conn., American Helicopter Society, Inc., 1947. 196 pp., illus., figs. $5.50 ($3.00 to members of the American Helicopter Society). A collection of 22 papers on helicopter theory and application. The technical aspects are treated in papers dealing with general design problems, rotor theory, vibration isolation effects of blade stalling, whirl testing of rotors, governors, transmissions, and test instrumentation. Other subjects discussed are legal regulation, operation, maintenance, safety, marketing, and naval, commercial, agricultural, and postal uses. Individual papers are available at $0.25 to members of the American Helicopter Society and at $0.50 to nonmembers.

LAW

Aviation Accident Law. Charles S. Rhyne. Washington, Columbia Law Book Co., 1947. 315 pp. $6.00. A compilation and analysis of all reported court decisions concerning claims that have arisen out of aircraft accidents. Consideration also is given to legislation and international conventions that have application in this field. The material has been collected over a period of 10 years.

MATERIALS

Notice of Revision to the Formed Shapes, Metallic Extrusions, Rubber & Miscellaneous Shapes Sections of the Standard Shapes Book. Revision 99A. Baltimore, The Glenn L. Martin Co., September 1, 1947. 36 pp., diagrs.

MATHEMATICS

Éléments de Mathématiques Supérieures (Elements of Higher Mathematics). P. Gaudiot. Paris, Éditions Léon Eyrolles, 1944. 381 pp., diagrs. Designed as a practical textbook, especially for those who wish to acquire quickly the application of theory to simple cases. Geometric representations are largely used for the study of the variation and continuity of functions, and geometric applications are used as much as possible. Numerous examples are included.

The Theory of Mathematical Machines. Francis J. Murray. New York, King's Crown Press, 1947. 116 pp., diagrs. $3.00. A comprehensive discussion of the basic principles of calculating machines. The fundamental requirements of both digital and continuous machines are considered, together with mechanical and electronic methods of meeting the requirements. An operational approach to the general question of the solution of mathematical problems by machines is proposed. Information is given about such mathematical instruments as the planimeter and the integraph. Their mathematical theory is discussed, and modern devices for the same purpose, based on photoelectric techniques, are studied. Some of the literature on the subject is given in a bibliography.

METALS AND ALLOYS

United States Patents on Powder Metallurgy. Raymond E. Jager and Rolla E. Pollard. U.S., National Bureau of Standards, Miscellaneous Publication No. M184. Washington, U.S. Govt. Printing Office, 1947. 139 pp. $0.30. A total of 2,253 patents are classified under four main headings: production, handling and working, alloying, and applications. The main headings are further subdivided under special methods, materials, and uses. The patents are listed numerically and each is accompanied by a brief abstract. The compilation is based on a collection search of United States patents of the present series, which began in 1836. Patents issued up to January 1, 1947, are included.

Manual of Aluminum Casting Alloys. Chicago Aluminum Research Institute, 1947. 78 pp., illus., figs. This manual contains the results of an investigation conducted by the Case Institute of Technology to determine the engineering properties of smelters' aluminum casting alloys. In Part I the mechanical and physical properties of the alloys are given in tabular form, along with pertinent specifications. In Part II the general effects of alloying, the characteristics of each type of alloy, the general requirements regarding foundry practice, and the effects of heat-treating are discussed.

Finishes for Aluminum. Louisville, Ky., Reynolds Metals Co., Inc., 1947. 2 Vols. 107, 122 pp., illus. $2.00 the set. Volume I outlines some properties of aluminum and gives details about characteristics and applications of the various finishes. Information is supplied about cleaning treatments; mechanical, chemical, and electrolytic oxide finishes; electroplated coatings; and special finishes. Volume II provides practical shop data in the form of standard process bulletins on materials, equipment, and solution preparation and control.

METEOROLOGY

Weather Horizons. Boston, American Meteorological Society, June, 1947. 79 pp., tables. A booklet in which information is presented about the role and activities of the American Meteorological Society, careers in meteorology, and meteorological education. The latter section contains examples of the types of courses being offered in schools where meteorology is given on an introductory or cultural basis.

MODELS

Model Motor Manual. Louis Garami and Howard McEntee. New York, Air Age, Inc., 1947. 227 pp., illus., diagrs. $3.00. Prepared to aid model builders in the intelligent use of their power plants, this manual provides practical information about the operation of model engines, the principles that form the basis of their design, and considerations affecting the design of their component parts. Most of the text is devoted to the two-stroke engine, but there are sections on the four-stroke engine, compression-ignition engines, and jet engines. Chapters discuss the electric system, fuel system, engine-starting technique, and trouble-shooting. Data tables contain more detailed information about the dimensions, performance, and construction of American-built model engines than heretofore has been published in tabular form. There is a need for certain revisions in the semitechnical discussions which undoubtedly will be made in the second printing.

QUALITY CONTROLS

Control Charts; An Introduction to Statistical Quality Control. Edward S. Smith. New York, McGraw-Hill Book Co., Inc., 1947. 161 pp., figs., tables. $3.00. The fundamentals of statistical quality control, with emphasis on practical applications rather than on mathematical development. An introductory chapter explains the importance of statistical methods as an aid to the control of quality. Subsequent chapters discuss frequency distributions; control charts for averages and ranges; and control charts for fraction defective, for number of defectives, and for number of defects and three-sigma limits. The author is Professor of Mathematics at the University of Cincinnati.

RADIO

Wireless Direction Finding. R. Keen. 4th Ed. London, Iliffe and Sons, Ltd., 1947. 1,059 pp., illus., diagrs. 45s. Despite the spectacular new applications of pulse technique for radio navigation and the location of obstructions, there must always remain the demand for a means of locating a source of electromagnetic radiation, which is the reason why a fourth edition of this book has been prepared. Opportunity has been taken to include much recently released material—in particular, systems of navigation using the hyperbolic grid. Other new material includes sections on the design and testing of high-frequency radiogoniometers, on transmission-line theory as applied to the Adcock antenna systems, and on the cause of reduction of resonance effects in Adcock antennas and feeders. The material on high-frequency direction-finding has been largely rewritten, and new sections on calibration have been added to the chapters on ship and aircraft navigation. Beacons are dealt with more fully by the addition of recent developments in U.S. radio-range beacons. The statistical classification has been included, together with notes on the organization of a network of high-frequency direction-finding, that is, the location of unidentified transmitters. Progress in aircraft approach and landing systems has been somewhat limited since 1938, but the section on this subject has been extended and describes the S.C.S.-51 system developed in the United States. As in previous editions, the book is intended to be a manual rather than a complete text. A comprehensive bibliography is included.

SPRINGS

Spring Design and Calculations. John A. Roberts. Redditch, England, Herbert Terry and Sons Ltd., Technical Research Laboratory, 1947. 114 pp., illus., diagrs. A practical handbook on the calculation of the loads, natural frequency, and power of commonly used springs of many types. Recommendations are made for the proper selection and purchasing of springs.

STRENGTH OF MATERIALS

L'Expérience et les Théories Nouvelles en Résistance des Matériaux (Experiments and New Theories in Resistance of Materials). R. L'Hermite. 2nd Ed. Paris, Dunod, 1945. 240 pp., diagrs. 235 fr. The first half of this book deals with classical theories of the strength of materials and their limitations in application. In the second part, recent experimental research is reviewed on the constitution of solids and the application of modern theory to the interpretation of phenomena of deformation and fracture. The author points out that his aim is to present a synthesis of the science of strength of materials as it exists today rather than a treatise. The discussion is documented by excellent critical bibliographies.

THERMODYNAMICS

Applied Thermodynamics. Virgil Moring Faires. Revised Ed. New York, The Macmillan Co., 1947. 480 pp., illus., diagrs. $4.75. A revised and enlarged edition of an introduction to heat power for college students with a knowledge of calculus and physics. Chief changes in the new edition are the lengthening of the discussions of basic principles, including the second law of thermodynamics; the addition of material on the internal-combustion turbine and heat transfer; and the increase in the number of equations and illustrations.

(Continued on page 72)

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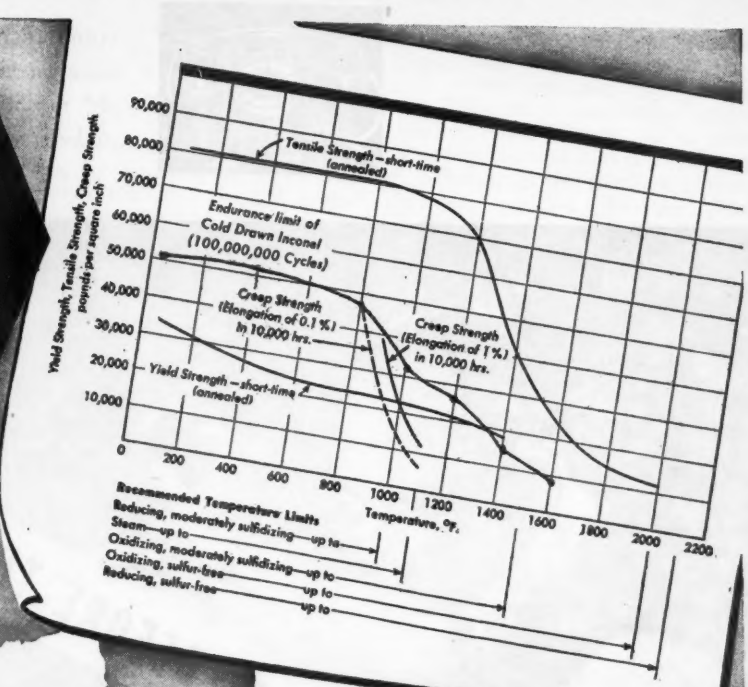

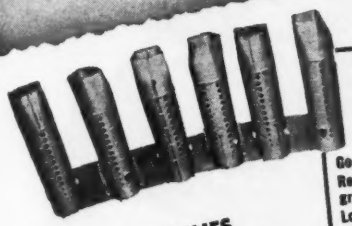

PROPERTIES REQUIRED
Corrosion Resistance at high temperatures.
Good heat transfer.
Resistance to progressive oxidation.
Low coefficient of expansion.
Resistance to thermal shock.

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In designing jet engines to power America's newest, fastest pursuit planes, engineers chose Inconel* for the combustion chamber liner assemblies, as shown above. In all 45 lbs. of .031" gauge Inconel strip is used per engine. Inconel's resistance to thermal shock plus its workability and weldability were important reasons why it was chosen for this demanding job.

PROPERTIES REQUIRED
Corrosion resistance at high temperatures.
Heat transfer.
Resistance to progressive oxidation.
Low coefficient of expansion.

HEATING UNITS

After 1100 hrs., this Inconel flash-type boiler was removed from an airliner in excellent condition. These boilers must resist stack temperatures higher than 1500°F.... withstand thermal shock caused by 200°F. return water... maintain clean surfaces for good heat transfer.

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PROPERTIES REQUIRED
High hot-strength.
Fatigue resistance.
Erosion resistance.
Corrosion resistance.
Resistance to progressive oxidation.

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A TELEPHONE RECEIVER is a complex system of electrical and mechanical elements. Its coils, magnets, diaphragm and cap react on each other as they convert the electrical waves of your voice to sound waves. What is the best size for the holes in the ear cap? Will 1/1000th inch greater thickness help a receiver diaphragm to carry your telephone voice more clearly? One way to find out is to build numerous experimental receivers and test them.

But Bell Laboratories have found a shorter way. They built an all-electrical replica, an "equivalent circuit" in which electrical resistance stands for air friction in the cap holes; capacitance corresponds inversely to the stiffness of the diaphragm. Over-all performance of this circuit can be quickly measured and design changes economically explored. Later, a model can be built for final check.

The "equivalent circuit" was pioneered by Bell Telephone Laboratories 25 years ago. It is a useful tool in many Laboratories developments—saving time, saving the cost of machine-tooled models, encouraging experimentation. It is one more example of the way Bell scientists get down to fundamentals as telephone progress continues—and service keeps on improving for all subscribers.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Sections and Branches

(*Continued from page 9*)

produced is proportional to the difference of velocity of the air over the upper camber and over the lower camber. The configuration of regularly used airfoils is such that the distance traveled by an air particle traversing the upper camber never exceeds the distance traveled by a particle over the lower camber by more than 5 per cent of the chord; therefore, the difference in velocity, which produces most of the lift, is relatively small, regardless of the absolute velocity of the relative wind.

Custer reasoned that, if the wing could be bent spanwise into a channel section and a propeller rotated within the channel, it would be possible to create an airstream over the inner camber of the channel having a velocity considerable greater than that of the air over the outer channel and that the lift would be increased accordingly.

▸ **Permits Vertical Ascent**—His contention was borne out by the fact that the prototype model has been able to develop a static lift of 8.2 lbs. per hp. with no forward velocity of the aircraft whatsoever. Wing loading is such that this permits vertical ascent and descent when desired, although Custer does not intend to present his design on that basis. He stated that the prototype was able to take off and land within 50 ft. during flight tests for A.A.F. at Beltsville, Md.

At the Section's first fall meeting, members were introduced to Willy Ley by Program Chairman Henry Billings. Ley, who is associated with the Washington Institute of Technology, is a ballistician and author of the newly revised book, *Rockets and Space Travel*. He is considered one of the nation's outstanding authorities on rockets.

▸ **Rocket History**—Ley began with a brief background description and history of rockets from their earliest inception, describing the development of powder rockets from their first crude form and uses in warfare up to World War II powder rockets of the "Tiny Tim" variety. In this type, fuel consisted of a powder "grain" of some 40 lbs. of slow-burning, smokeless powder extruded to such a shape that the burning area remained essentially constant as the charge was consumed, and the production of exhaust gases was therefore carried on at a fairly constant rate.

It was pointed out that both the thrust and speed of a rocket can be materially increased by an increase in the exhaust velocity. This consideration points further research in the direction of liquid-fueled rockets, which have higher exhaust velocities and can be constructed with higher mass ratios (the ratio of weight before burning fuel to weight after fuel consumption), since they do not encounter the extremely high internal pressures produced in powder rockets.

▸ **Liquid Fuel Development**—Ley then described development of liquid-fueled rockets by the German Rocket Society and by Dr. Robert Goddard in America. Considerations in the choice of fuels were discussed at some length, as were some of the results obtainable by use of these fuels. It was revealed that the mixture of water with the fuel produced increased thrust due to improved cooling, which was also produced in some instances by pumping fuel to the rocket motor through a surrounding jacket, making the fuel act as a coolant.

Some of the achievements in the rocket field to date were given which yielded an interesting picture of what may be expected in the way of practically attainable exhaust velocities and mass ratios.

Ley concluded by stating his belief that within the next few decades a rocket would be developed capable of sufficient speed and altitude to fall into an orbit about the earth.

During a discussion period following the meeting, Ley elaborated on the orbital rocket theme, explaining its practical value not only as a stepping-stone to space travel but as a research station where unique temperature and pressure conditions could easily be obtained and as an observatory free from atmospheric disturbances.

Wichita Section

J. H. Gerteis, *Secretary*

Officers elected for the coming fiscal year are as follows: Chairman, Tom Salter; Vice-Chairman, Preston E. Dickson; Treasurer, Wilfred Pearce; and Secretary, J. H. Gerteis.

Academy of Aeronautics

In two meetings in September held at LaGuardia Field under chairmanship of Marvin Glenn, members heard descriptions of the autogiro and of the helicopter.

On September 9, E. D. Rice, President of the Autogiro Company, explained some of the developments of the autogiro. Using a scale model, Rice described the automatic turning of the blades to exert a lifting force, the action of gravity in keeping the blades revolving, how the blades are hinged, and why they do not fold up like an umbrella.

As a demonstration, the autogiro was shown taking the jumps on a racetrack at about 8 m.p.h. and hovering aloft motionless in a 20 m.p.h. breeze.

At the September 23 meeting, members saw the film *The Story of the Helicopter*, with explanations by Mr. Gagarin of the Sikorsky Aircraft Division, United Aircraft Corporation, Bridgeport, Conn. The film covered the development of the helicopter from its beginnings, and including the first helicopter flight made by Sikorsky. Changes in design over the years were shown and some of its many uses were illustrated. The film ended with the presentation of the latest two-place S-52 model.

Aeronautical University

The August 29 Branch meeting was for the purpose of electing officers for the fall semester. The following members were elected: Charles White, Chairman; E. R. Baker, Vice-Chairman; J. T. Deden, Secretary; C. G. Freund, Treasurer, and L. F. McNamara, Sergeant-at-Arms. New committees were formed on a volunteer basis.

University of Illinois

Principal speaker at the August 27 meeting was Prof. H. S. Stillwell, Head of University's Aeronautical Engineering Department. Subject of Professor Stillwell's talk was "Trends in the Aeronautical Field."

The talk was divided into three main parts: state of the aircraft industry, status of the University of Illinois' curriculum, and research work being carried on by the Aeronautical Engineering Department.

Professor Stillwell stressed that, although the aircraft industry is on a downhill slide this year, the industry is far from becoming unstabilized; in fact, the prevailing conditions are tending to stabilize the industry because of the intense planning and management control operations these circumstances have necessitated.

The present plan of the University of Illinois to make theory tie in more closely with the practical side of aeronautics was mentioned. The curriculum, Professor Stillwell said, is constantly being revised to meet the latest trends in the aviation field.

In closing, the professor named a few of the research programs operating under the supervision of the Aeronautical Engineering Department. These included a Navy contract for a supersonic ram-jet (under personal direction of Prof. R. W. McCloy), a

small supersonic wind tunnel (20 lbs. per sq.ft. at 140 lbs. per sq.in.), a contract for a supersonic propeller, and the erection of a new research building at the University airport to house the Aircraft Engines Laboratory (also the site of experimentation on the supersonic ram-jet).

Presiding officer for the meeting was John McGuire, Chairman.

At the September 10 meeting, two Bell Aircraft Corporation films were shown and officers were elected.

The films, *Planes Without Pilots* and *Report on Jet Propulsion*, traced the development of jet propulsion in the United States, stressing origination of the Bell Airacomet. Both technical and nontechnical aspects of the films impressed the students, faculty, and guests, numbering 55.

A short business meeting concluded the session, the following members being elected to office: Robert Chubb, Chairman; John Prodan, Vice-Chairman; and Edward Brisick, Secretary-Treasurer.

University of Notre Dame

A business meeting of the Branch was held September 23 with Joseph M. O'Hara presiding.

Chairman O'Hara summarized plans for the coming semester and appointed various committees. The Head of the Aeronautical Department, F. N. M. Brown, made a brief welcoming speech and indicated his desire for the resumption of the club paper, *The Burble*.

Parks College of Aeronautical Technology

Two meetings in September were held by the Parks College Branch—September 4 and 18.

The first meeting was conducted in conjunction with the Aeronautic Engineers banquet. Principal guests at the banquet were Oliver Parks; Edward Barker, Head of the Aeronautical Engineering Department; Mr. Hertenstein, Head of the Mathematics Department; Mr. Horn of Engineering Drawing; and Kenneth Willard, the principal speaker.

Institute of the Aeronautical Sciences awards were presented to Norman Painter and John Gard of the graduating engineers for scholarship achievement.

Election of officers constituted the main business of the September 18 meeting. These included Richard Dean, Chairman; Milton Sheppard, Vice-Chairman; Charles Beckman, Treasurer; LeRoy Varga, Recording Secretary; and A. Anzanos, Corresponding Secretary.

A film, *Everyday Miracles*, was shown, presenting the methods used in production of Carboloy products and a brief history of the discovery of carbon.

Charles Jahn, Presiding Officer, announced that a trip to McDonnell Aircraft Corporation was still pending because of Navy regulations.

Polytechnic Institute of Brooklyn

Chairman Hrant Yousoufian opened the September 30 meeting with a brief summary of the agenda for the year. The program includes plant inspection trips as well as regular meetings.

The floor was then turned over to Paul Lieber, Assistant Professor of Applied Mechanics, who presented to those newly eligible for student membership in the I.A.S. the advantages to be derived from association with the Student Branch.

Remainder of the meeting was devoted to the showing of the film, *The Story of Willow Run*. The subject included not only the production and assembly of parts into complete planes but also the history of the development of the structures that comprise Willow Run.

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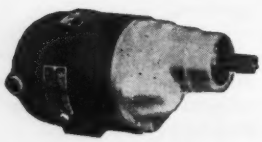

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Spartan College

A raffle was held at the September 30 meeting to raise funds for a banquet given the graduating class. The banquet, which was held at the "Bit of Sweden" in Tulsa, was very much enjoyed by all attending.

Gene Hess was elected to head a committee for the rewriting of the Branch constitution, and Franklin T. Nelson to succeed Charles Gruenberg as Corresponding Secretary.

News of Members

Gaetano V. Amico, former A.A.F. Lieutenant, is Sr. Stress Analyst, Republic Aviation Corp.

Lee Arnold is with Biot & Arnold as Co-Director, Consulting & Research in Applied Physics.

Judson Richard Baron, formerly with United Aircraft, is attending Graduate School at M.I.T.

Henry Berman resigned from Republic Aviation to take an appointment as Mechanical Engineer, Langley Memorial Aeronautical Laboratory, N.A.C.A.

Mitchel Bertram, former Aeronautical Engineer with U.S.A.F., was appointed Aeronautical Engineer at Langley Memorial Aeronautical Laboratory, N.A.C.A.

Leon Beskin is with Bureau of Aeronautics, Navy Dept., as Assistant Chief for Design and Research.

Howard T. Carson left M.I.T. to accept appointment with Boeing Aircraft Co. as Engineer.

Laurance H. Cooper is Vice-President, Trans Air. Cooper was with Consolidated Vultee as General Sales Manager, Stinson Division.

Leon Crane is Flight Test Engineer, Piasecki Helicopter Corp. He resigned as Flight Test Engineer and Aerodynamicist with Firestone Aircraft Corp.

Lyle Martin Crist is Instructor, Department of English, Iowa State University.

Robert Cooper Curry, former A.A.F. Lieutenant, resigned as Time Study Engineer and now is with American Airlines as Engineer, Structures Section of Service Engineering Division.

Frederick J. DeMeritte is working on the Guided Missile Program at Naval Ordnance Laboratory, White Oak, Md.

James Demetropoulos is Jr. Engineer, Wright Aeronautical Corp.

Gordon W. Ellis resigned from Bell Aircraft to become Draftsman, Engineering Laboratory, Ford Motor Co.

George Gerard, formerly Principal Research Engineer with Republic Aviation, has been appointed Instructor at New York University. He will work on research projects in addition to working for his doctorate.

Arthur C. Gilbert, who received his Masters Degree in Ae.E. from New York University, is Research Aeronautical Engineer at N.A.C.A.'s Langley Memorial Aeronautical Laboratory.

Joseph A. Hahn is Associate Professor of Engineering, Lingnan University (China), teaching applied mechanics, structural design, and advanced structures.

Miss Murray Hake is Passenger Agent, Colonial Airlines, Inc.

Robert A. Hall, former Research Engineer with British Airways Ltd. in England, is Technical Advisor (Civil), Fairey Aviation Co. Ltd.

Tse-Hwa Han, former student at University of Michigan, is Engineer, Gloster Aircraft Co., Great Britain.

Frank H. Hoernschemeyer, Jr., resigned as Stress Analyst with Douglas Aircraft to accept same position with McDonnel Aircraft Corp.

Jacque Houser is now with University of Illinois as Assistant Professor of Aeronautical Engineering.

John K. Hubbard is Chief Test Engineer, Centrifugal Engineering, Clark Brothers Co., Inc.

George W. Hughes, Jr., formerly with Consolidated Vultee as Aeronautical Engineer, a Navy veteran, is Chief Engineer, Alad Co.

Charles H. Kahr, Jr., is Assistant Professor of Aeronautics at Naval Postgraduate School, U.S. Naval Academy, Annapolis, Md.

Leon Kaplan is Structural Engineer with Edo Aircraft Corp.

Peter B. Kline is with N.A.C.A., Langley Memorial Aeronautical Laboratory, as Aeronautical Engineer.

Edmund Victor Laitone resigned from Cornell Aeronautical Laboratory to become Associate Professor, Department of Mechanical Engineering, University of California.

George T. Lalos, former Navy Ensign, is Mechanical Engineer, National Bureau of Standards.

Dr. Henry L. Langhaar resigned from Consolidated Vultee to become Associate Professor of Theoretical and Applied Mechanics, University of Illinois.

Joseph W. Lawsing is with Chance Vought Aircraft Division of United Aircraft Corp. as Liaison Engineer.

Eugene K. Liberatore is Engineer, Naval Aircraft Factory, Philadelphia.

Jack R. Lind now is Aerodynamicist, Douglas Aircraft Co., Inc.

George Liner has been named Research Engineer in Full Scale Division, Langley Memorial Aeronautical Laboratory, N.A.C.A.

Charles C. Love, Jr., resigned from Boeing to become Mechanical Engineer at Solar Aircraft Corp.

Frank M. Mallett, former Sr. Research Engineer with Curtiss-Wright, is at Ohio State University as Instructor, Department of Aeronautical Engineering.

Herbert Mandelbaum is with Charles Mayer, consulting engineering office, New York City.

C. H. Marshall, former Chief Design Engineer for transport planes, Curtiss-Wright Corp., now is Secretary-Treasurer of George E. Wells, Inc.

Stephen H. Maslen is Aeronautical Engineer, Aircraft Engine Research Laboratory, N.A.C.A.

George D. McLean, A.A.F. veteran, is Flight Test Engineer, Chance Vought Aircraft Division of United Aircraft.

Thomas E. Nicholas resigned from Simmonds Aerocessories to become Research Engineer—Thermodynamics, Consolidated Vultee Aircraft Corp.

Frank E. O'Brien, Flight Engineering Inspector, Department of Commerce, C.A.A., resigned to accept a commission as Major, U.S.A.F.

John J. Palermo, A.A.F. veteran, is Chief Machine Designer, Schultz Engineering Corp.

Raymond A. Pederson is Engineer (Mechanical Equipment), Boeing Aircraft Co.

Herbert E. Peitzer has been appointed Research Engineer, Helicopter and Vibration, Langley Memorial Aeronautical Laboratory, N.A.C.A.

Harry B. Picken is Chief Engineer, Weston Aircraft Ltd. (Canada).

Jean C. Roby resigned from The Glenn L. Martin Co. to become Designer with Piasecki Helicopter Corp.

Frank D. St. Hilaire is Inspection Coordinator, Lummus Co.

Mark Robert Seldon, former N.A.C.A. Electrical Engineer, is with Chance Vought Aircraft as Instrument Engineer, Flight Test Section.

Dr. Edward W. Suppiger, former A.A.F. Lt. Col., is Associate Professor at Princeton University.

Ned M. Thorne is Dayton representative of Standard Aeronautical Index, conducted by the Institute.

Angelo Samuel Tuminello is engaged in the building and designing and sales of miniature aircraft.

Robert G. Urquhart is Sr. Aerodynamicist, Ordnance Research No. 1, University of Chicago.

Arnold C. Ward, Stress Analyst with Douglas, resigned to become Stress Analyst with Consolidated Vultee Aircraft Corp.

Emil Edwin Weibel is Associate Professor of Mechanical Engineering, University of Colorado.

John Albert Whitaker was named Designer, Consolidated Vultee Aircraft Corp.

Robert L. Whitelaw was appointed Special Projects Engineer, Aircraft Gas Turbine Division, De Laval Steam Turbine Co.

Herman C. Weiben, Jr., has left The Glenn L. Martin Co. for Fairchild Air-

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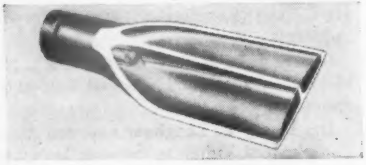

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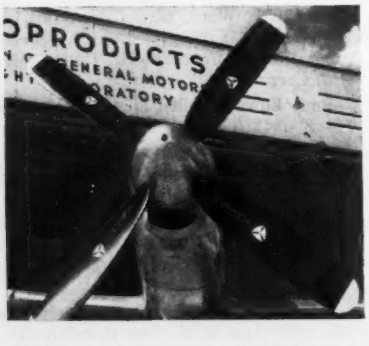

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craft Division, Fairchild Engine & Airplane Corp.

Charles L. Wight, Jr., is Major Layout Draftsman with Chance Vought Division, United Aircraft.

Kenneth Withington, former Head of Aeronautical Engineering Department, Mississippi State College, accepted a commission in U.S.A.F. as Major. He is presently stationed at the New Mexico School of Mines, Research & Development Division, for duty with Navy Bureau of Ordnance.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Berman, Leon Jerry, B.Ae.E., Research Engineer, Aircraft Research & Development Div., Willys-Overland Motors, Inc.

Bridgland, Edgar Parsons, Ae.E., Chief Experimental Officer, Winter Experimental Establishments, R.C.A.F.

Glasgow, Charles Steward, Jr., M.E. in Ae., Project Engineer, Douglas Aircraft Co., Inc.

Perry, Julian Packard, B.S. in Ae.E., Chief Engineer, Helicopter Type Aircraft, Firestone Aircraft Co.

Smith, William Mage, Chief of Laboratories, Bell Aircraft Corp.

Elected to MEMBER Grade

Burrows, William F., M.E., Chief Project Engineer, Aircooled Motors, Inc.

Chilton, Robert Creed, B.S., Engineering Test Pilot, North American Aviation, Inc.

Denney, Corwin Dwight, B.S. in Ae.E., Chief, Helicopter Div., Direct Helicopter Research & Development, Marquardt Aircraft Co.

French, G. Thomas, B.S. in Industrial Engineering, Testing Engineer, in charge of Mechanical Lab., Bell Aircraft Corp.

Fresh, John Norman, Asst. Head, Aerodynamic Investigations Section & Head, Wind Tunnel Group 1, Aeromechanics Div., David Taylor Model Basin, Navy Dept.

Heath, Royal V., Jr., M.E., General Manager, The Heath Company.

Holschuh, Carl G., B.S. in C.E., Vice-President and Works Manager, Sperry Gyroscope Co., Inc.

Jones, Anthony Warren, B.S. (E.E.), Project Engineer (Aeronautical Research), Aircraft Engine Research Lab., N.A.C.A.

Kasley, Jack Hare, M.S., Chief Aerodynamics Engineer, Propeller Div., Curtiss-Wright Corp.

Liggett, William Henry, M.Sc., Instructor, Airplane Design & Stress Analysis, Northrop Aero. Inst. (Northrop Aircraft, Inc.).

Ludwig, John Warren, S.B., Vice-President in Charge of Engineering, Electronic Control Corp.

Mancusi, Joseph John, Jr., B.A., Project Engineer, Hydra-Power Corp.

McCrea, Russel J., B.S. in M.E., Aerodynamicist "A," Preliminary Design & Test of Supersonic Aircraft, Consolidated Vultee Aircraft Corp.

Perna, Angelo J., M.S. in Ae.E., Sr. Structures Engineer, Pilotless Plane Div., Fairchild Engine & Airplane Corp.

Roth, Marshall Stanley, B.S., Col., Chief, Guided Missiles Section, A.M.C., U.S. Army Air Forces.

Smith, Sheldon Phelps, B.A., Engineering Designer (Guided Missiles), Douglas Aircraft Co., Inc.

Strauss, Louis, B.S. in M.E., Aeronautical Engineer, Naval Air Missile Testing Center (Pt. Mugu, Calif.).

Thorne, Ned M., B.S. in M.E., Project Engineer P-3, Instrumentation Unit, Power Plant Lab., Air Materiel Command (Wright Field).

Willson, Robert deBruin, B.S. in M.E., Chief, Engine Branch, Air Technical Intelligence, U.S. Army Air Forces.

Zepke, Walter W., Engineering Representative, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Transferred to MEMBER Grade

Ames, Milton Benjamin, Jr., B.S. in Ae.E., Head, Aerodynamics Research Group, N.A.C.A. (Washington, D.C., Office).

Andreoli, Douglas G., Flight Test Liaison Engineer, Chance Vought Aircraft Div., United Aircraft Corp.

Boseker, F. John, Jr., Structures Engineer "A," Hughes Aircraft Co.

Brown, Robert, Acting Asst. Supt. of Servicing, South African Airways.

Coates, Edmund William, Dipl. in Aeronautics, Section Leader, Design Office, Auster Aircraft Limited (England).

Davis, Robert Baxter, B.S. in M.E., Laboratory Research Analyst "A," Lone Star Lab., Consolidated Vultee Aircraft Corp.

Dennis, Lester Thompson, B.S. in Ae.E., Aircraft Propeller Vibration Engineer, Power Plant Engineering Div., C.A.A.

Downing, George Grandeville, Principal Research Engineer, Monsanto Chemical Co.

Gosnell, Hugh Hanlan, B.S. in Ae.E. Stress Analyst, Canadair Ltd. (Canada).

Hjorth, Harry Ernest, Asst. Chief Power Plant Engineer, Douglas Aircraft Co., Inc.

Konikoff, John J., B.S. in M.E., Project Engineer, Aero. Structures Lab., Flight Test Section, Naval Air Experimental Station (Philadelphia).

Martin, William John, Flight Capt., Consolidated Vultee Aircraft Corp.

McFarland, Donald Lee, B.S. in Ae.E., Design Engineer, Development Group, Chance Vought Aircraft Div., United Aircraft Corp.

Miller, Herbert Hutchison, Project Engineer, Fuselage Group, Cancargo Aircraft Mfg. Co. Ltd.

Milwitzky, Benjamin, B.Ae.E., Aero. Engineer, Impact Loads Section, Langley Mem. Aero. Lab., N.A.C.A.

Nylin, Nels Ernest, B.S. in M.E., Tool Project Engineer, Consolidated Vultee Aircraft Corp.

Peters, Robert John, B.S. in Ae.E., Sr. Stress Analyst, Airplane Div., Curtiss-Wright Corp. (Columbus).

Phillips, Frederick Clayton, B.Ae.E., Prof. of Aircraft Design, Institute of Technical Aeronautics, Branch of the Brazilian Air Ministry.

Preisick, G. Roger, B.S. in Ae.E.

Robinson, Harold Lester, B.S. in Ae.E., Research Scientist, Langley Mem. Aero. Lab., N.A.C.A.

Theobald, Phillip E., B.S. in M.E. (Aero Option), Research Engineer, Aero. Research Center, University of Michigan.

Wehle, Louis Brandeis, Jr., S.B. (Physics Eng'g.), Stress Analyst, Grumman Aircraft Engineering Corp.

White, Richard Pancoast, B.S. in Ae.E., Vice-President (Aero. Eng'g. Design Studies), Westcoast Engineering Development Co.

Zabriskie, Jesse Henry, M.S. in Ae.E., Project Engineer, Guided Missiles Section, A.M.C. Wright Field.

Elected to Associate Member Grade

Fiala, Joseph N., Civilian Asst. to Deputy Commanding General for Research & Development, A.M.C., U.S. Air Forces (Wright Field).

Mayer, Roberto, Director, Secretary (Curtiss-Wright Corp.); Representative, Cobaires S.A. (Argentina).

Slaw, Lewis Hadway, Jr., Equipment Specialist, Technical Group, Naval Aviation Supply Office (Philadelphia).

Transferred to Associate Member Grade

Takei, William Tohoru, B.S. in Ae.E., Design Engineer, Landing Gears, Aero. Flight Aircraft Corp.

Elected to Technical Member Grade

Abramson, Hyman Norman, Engineers Aide, Aerodynamics Section, Lab. Dept., U.S. Naval Air Missile Test Center.

Benedict, Ralph Gordon, B.S. in Ae.E., Graduate Student, Syracuse University.

Heaslip, William Thomas, B.A.Sc., Jr. Stress Analyst, De Havilland Aircraft of Canada, Ltd.

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Marshall, Rolf Frederick, B.Sc. (Eng.), Asst. Chief, The Chrislea Aircraft Co. Ltd. (England).

Mendelson, Alexander, B.M.E., Mechanical Engineer P-4, Aircraft Engine Research Lab., N.A.C.A.

Petrides, Alex, Standards Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Pritchard, Ernest I., B.S., Mechanical Engineer P-2, Wind Tunnel Div., Aircraft Engine Research Lab., N.A.C.A.

Transferred from Student to Technical Member

Barson, Zelmar, B.S., Aeronautical Research Engineer, Aircraft Engine Research Lab., N.A.C.A.

Bland, David Morton, B.S. in Ae.E., Engineering Trainee, Chance Vought Aircraft Div., United Aircraft Corp.

Bos, Jack Robert, B.Ae.E., Engineering Trainee, Chance Vought Aircraft Div., United Aircraft Corp.

Bright, Loren G., B.S. in Ae.E., Aeronautical Engineer, Ames Aero. Lab., N.A.C.A.

Clevenger, Lyle C., Student (Sr.), Iowa State College.

Ellestad, Ernest Andrew, B.S. in M.E., Stress Analyst "B," Northrop Aircraft, Inc.

Frownfelter, Charles Robert, B.S. in M.E., Research Engineer, Goodyear Aircraft Corp.

Griffin, Roy N., Jr., B.S. in Ae.E., Graduate Student, A. & M. College of Texas.

Hampton, Louis R., Ae.E., Sales Engineer, Wallace & Tiernan Co. Inc.

Hilton, Harry Herbert, B.Ae.E., Graduate Asst., New York University.

James, Carlton Starbuck, M.S., Aeronautical Engineer, Ames Aero. Lab., N.A.C.A.

Kapryan, Walter Joseph, B.S. in Ae.E., Aeronautical Engineer P-1, Langley Mem. Aero. Lab., N.A.C.A.

Liess, Herman Michael, B.Ae.E.

McFadden, Norman M., A.B., Aeronautical Engineer, Ames Aero. Lab., N.A.C.A.

Mleczko, William Joseph, B.S. in Ae.E., Design Draftsman, Rock-Ola Mfg. Co.

Muggleton, Eugene C., Ae.E.

Nuckolls, Alvin Sammons, Jr., B.S. in M.E. (Aero Option).

Oesterling, Warren Elsworth, B.S. in M.E., Engineering Trainee, Cooper-Bessemer Corp.

Pedersen, Paul E., B.S. in Ae.E.

Peterson, Arthur H., M.S., Aerodynamicist, RAND Project (Calif.)

Pryor, Shepherd Green, III, B.S. in Ae.E.

Rainey, Albert Gerald, B.Ae.E., Aero. Engineer, Grade P-2, Langley Mem. Aero. Lab., N.A.C.A.

Roberts, William M., B.Ae.E., Aeronautical Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Shatunoff, Stanley, B.Ae.E., Research Asst., Polytechnic Institute of Brooklyn.

Tummel, Harold Edward, B.Ae.E., Jr Engineer, Wright Aeronautical Corp.

Turner, Robert Lincoln, Jr., B.S. in M.E.

Vawter, Jack Lafayette, Associate in Arts.

Walker, Harold James, M.S., Aeronautical Research Scientist, Ames Aero. Lab., N.A.C.A.

Wardman, Charles E., B.S., Engineer, Commercial Welding Works, Inc.

Whitehill, William Jones, B.S. in Ae.E., Jr. Aerodynamicist, McDonnell Aircraft Corp.

Weida, Harold E., B.S. in Ae.E., Designer, North American Aviation, Inc.

Woods, Phineas S., M.S., Research Engineer, Midwest Research Institute.

Young, William Charles, B.S. in Ae.E., Experimental Engineer, Bendix Products Div., Bendix Aviation Corp.

Zoudlik, Rudolph Joseph, B.S. in Ae.E., Draftsman, Engineering, Piasecki Helicopter Corp.

Zwemer, Howard Adrian, S.B., Aeronautical Engineer, Project Meteor, M.I.T.

I.A.S. National Meeting Schedule

Wright Brothers Lecture—U. S. Chamber of Commerce Auditorium, Washington, D.C.—December 17, 1947

Sixteenth Annual Meeting—Hotel Astor, New York—January 26–29, 1948

Members or organizations wishing to submit papers for presentation at National Meetings should send outlines or summaries to the Committee at least 3 months prior to the meeting.

All papers submitted will be considered for publication in the *Journal of the Aeronautical Sciences* or the *Aeronautical Engineering Review*.

All correspondence should be addressed to The Meetings Committee, Institute of the Aeronautical Sciences, 2 East 64th Street, New York 21, N.Y.

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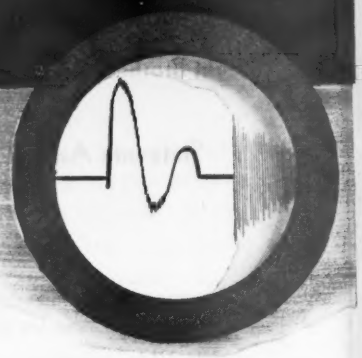

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Aerodynamicists and Aeronautical Engineers—Positions available for highly qualified technical personnel with good theoretical or experimental background to engage in development and model test work in stability, control, high-speed, and supersonic aerodynamics. Projects include new models of piloted and pilotless aircraft, new wind tunnels and associated equipment, and advanced testing techniques. Salary in accordance with qualifications and Civil Service regulations. In reply, please give brief summary of personal qualifications, education, and experience. Address—Director, David Taylor Model Basin, Washington 7, D.C.

Instructor or Professor—To take charge of, and to teach, subjects in the aeronautical option of mechanical engineering department. Subjects consist of aerodynamics, airplane design, internal combustion engines, etc. Complete laboratory equipment, including B-17 Flying Fortress, P-51 Fighter, Link trainers, and wind tunnel. Rank and salary dependent on qualifications. Teaching experience not necessary. Applicants should write to the Department of Mechanical Engineering, Montana State College, Bozeman, Mont.

Jet Power Plant Specialists, Theoretical Aerodynamicists—Experienced men needed for development work on subsonic and supersonic guided missiles. Write to or apply at Marquardt Aircraft Company, 4221 So. Lincoln Blvd., Venice, Calif.

Engineers—Long-term helicopter development program for Army Air Forces requires additional engineering personnel: (1) stress engineers with 4 or more years' experience, (2) senior layout men, and (3) mechanical draftsmen. Apply in writing to Manager, Helicopter Division, Kellett Aircraft Corporation, North Wales, Pa.

The U.S. Naval Air Station, Pensacola, Fla., is accepting applications of highly qualified and experienced personnel for various positions as follows: **Industrial Engineer, P-6** at $7,102.20 per annum, P-3 at $4,149.60 per annum; **Organization and Methods Examiner, CAF-9** at $4,149.60; **Methods Examiner—Forms, CAF-7** at $3,397.20 per annum; **Engineer Draftsman—General, SP-6** at $2,644.80 per annum; **Statistical Draftsman, CAF-5** at $2,644.80 per annum. Applicants may obtain Civil Service Application Form 57 from their local post office. Forward applications, completely filled out, to the Recorder, Board of U.S. Civil Service Examiners, U.S. Naval Air Station, Pensacola, Fla.

Professors and Instructors in Aeronautical Engineering—With the changed Aeronautical Engineering course from 4 to 5 years and extended graduate study facilities, the University of Minnesota, Department of Aeronautical Engineering, has positions available for a full professor in aeronautical engineering with industrial experience; assistant professor in modern theoretical and applied aerodynamics; and two instructors in the field of general aeronautics. Applicants must have Aeronautical Engineering degree and M.S. degree for higher positions. Extra compensation for summer work and opportunities for part-time research. Address: Department of Aeronautical Engineering, University of Minnesota, Minneapolis, Minn.

Assistant Professor—To teach courses in aircraft structures. The primary duties of the position will be concerned with aircraft structures, but the applicant should possess enough knowledge of aerodynamics to permit him to assist occasionally in elementary aerodynamic courses. Prefer a man with teaching and practical experience. In applying, please give brief sketch of personal qualifications, education, and experience. Address: Acting Dean R. P. Davis, College of Engineering, West Virginia University, Morgantown W.Va.

Aircraft Dynamics Engineers—For research work on subsonic and supersonic flutter, vibration, dynamic loads, stability and control of supersonic missiles, and helicopter dynamic problems. Applicants must have good background in fundamentals of applied mechanics and mathematics. Advanced degree or previous experience in field is essential. Salaries commensurate with training and experience. Cornell Aeronautical Laboratory, Employment Office, 4455 Genesee St., Buffalo 21, N.Y.

Servomechanism Engineers—Experienced in analysis, design, or testing of electrical or hydraulic servomechanisms or powered flight controls. Strong knowledge of stability analysis and test methods desired. Salary commensurate with training and experience. Inquire Personnel Manager, Boeing Aircraft Company, Seattle 14, Wash.

Structures Engineers and Stress Analysts—Experienced in aircraft structures and stress analysis. Three to 10 years' or more experience desired. Salary commensurate with training and experience. Inquire Personnel Manager, Boeing Aircraft Company, Seattle 14, Wash.

Hydraulic Engineers—Experienced in design and analysis of aircraft hydraulic mechanisms and components. Salary commensurate with training and experience. Inquire Personnel Manager, Boeing Aircraft Company, Seattle 14, Wash.

Mechanical Design Engineers—Experienced in design of light high-speed rotating machines. Also experienced in light and medium aircraft-engine and engine accessory design. Salary commensurate with training and experience. Inquire Personnel Manager, Boeing Aircraft Company, Seattle 14, Wash.

Stress Analysts—Personnel with experience on sheet metal, monocoque, cargo-type aircraft desired. Graduate engineers with 5 or more years' experience preferred. All replies held confidential. Write, Project Engineer, Chase Aircraft Company, Inc., West Trenton, N.J.

Chief Aerodynamicist—Services of highly qualified person to act as chief aerodynamicist. All applicants must be graduate engineers of recognized universities. Experience on cargo or large type of aircraft desirable. Applicants should write, giving complete details of education and experience, list references and salary expected, as well as availability. All replies held confidential. Write, Project Engineer, Chase Aircraft Company, Inc., West Trenton, N.J.

The number preceding the notices represents the Box Number of the Institute of the Aeronautical Sciences to which inquiries should be addressed.

Assistant Professor—Assistant Professor of Aeronautical Engineering wanted to teach junior and senior courses at Oregon State College. A man with graduate degree, teaching and industrial experience preferred. Address replies to B. F. Ruffner, Oregon State College, Corvallis, Ore.

800. Assistant Professor—Dynamics—A leading state university with recognized department of aeronautical engineering and both undergraduate and graduate divisions needs permanent staff member to give courses in vibrations, flutter, and the dynamics of the airplane and to direct graduate research in this field. Position is permanent. Rank—Assistant Professor or higher. Salary attractive. M.S. degree and experience in aircraft industry necessary. Position to start February 1, 1948.

799. Associate or Professor—Middle West state university with strong graduate division in aeronautical engineering needs additional new permanent staff member to develop and give instruction in the general field of supersonic aerodynamics and to direct basic and applied research in this field. Rank—Associate Professor or higher. Salary attractive. Starting date February, 1948, but can wait until September, 1948, if necessary.

798. Airplane Flight-Test Engineers—Aerodynamicists with experience in stability and control work and flight testing. Position requires a good academic background and sound knowledge of dynamics and applied mathematics. Advanced degree desirable. Must have training, experience, and ability to assume major responsibility in both the theoretical and experimental flight-test phases of major programs of aircraft flight dynamics and be familiar with standard methods of flight-test data reduction.

796. Chief Stressman—With C.A.A. requirements experience, and one or two assistants, to take charge new project. Reply stating full particulars of past experience, salary required, and when free to take up a new position.

762. Engineer—Graduate engineer, mechanical, experienced in precision transmission systems. Aggressive expanding company. Suburb of Philadelphia. Replies will be kept confidential. Send complete résumé.

761. Junior Electrical Engineers—Graduate engineers from recognized universities preferred. To work on aircraft electronic systems. Plant located in suburb of West Philadelphia. All replies will be held confidential.

760. Aircraft Electronic Engineer—Experienced in flight-test instrumentation. Plant located in suburb of West Philadelphia. All replies will be held confidential.

742. Automatic Pilot Project Engineer—Wanted by leading manufacturer of electromechanical equipment with a complete automatic pilot staff, including top-notch gyro engineers, servo engineers, and electronic engineers. Requires experienced automatic pilot engineer to take charge of automatic pilot engineering to relieve company chief executive who has handled this personally heretofore but requires a project engineer because of increased work and expanding

program. Individuals in our employ know of this opening so applicant need not be concerned about writing to his own employer. Location Middle West.

741. Metallurgist—College graduate with several years' experience in aircraft industry on control of materials, processes, and process inspection. To assume charge of quality control. An expanding aircraft concern, with excellent future. All replies will be held confidential. East Coast company.

739. Instructor or Assistant Professor—To teach courses in aircraft structures or aerodynamics in Aeronautical Engineering Department in Midwestern university. Minimum of 5 years' practical experience required; master's degree and previous teaching experience desirable. In replying please give complete record of personal qualifications and experience.

AVAILABLE

797. Dynamics, Vibration, and Flutter Specialist—Thirteen years' academic and industrial experience in this field. Holding considerable unpublicized knowledge for employer desiring high caliber services. Supervisory rank not mandatory, but equivalent salary. Please describe opening.

795. Aeronautical Engineer-Pilot—B.S. in Ae.E. from University of Michigan. Age 32; married. Two years in present position designing major units for leading aircraft manufacturer. Familiar with Army, Navy, and C.A.A. requirements. Naval aviator for 7 years. Two thousand four hundred hours flight time. Two years' experience supervising 25 mechanics and maintenance of 20 dive bombers aboard an aircraft carrier. Seven months as executive officer. At present, commanding officer of an air group and fighter squadron in the Organized Naval Reserve, with former rank of Lieutenant Commander. Holds C.A.A. commercial single and multiengined land and instrument ratings. Desires position combining flying and engineering or flying and administrative-executive work.

794. Engineer—M.E., M.M.E., Ph.D.; age 42. Associate Professor teaching applied mechanics and fluid mechanics. Some industrial research experience in stress analysis and mechanical design. Broad general background in mechanical and aeronautical engineering. Desires position in industrial research and development or as head of department teaching applied mechanics.

793. Graduate Aeronautical Engineer—Eight years' layout and design experience. Twenty-six months' service as aeronautical engineer, Naval Aircraft Factory. Also college instructor in engineering drawing for two terms. Desires position in supersonic or guided missile research or rotary-wing field.

792. Electronics Engineer—Age 26; B.S.E.E. 1943, and graduate study for the degree M.S.E.E. Three years' Army radar experience and 1½ years' experience with an Eastern aircraft concern as an electronics engineer. Has been associated with development of radio-controlled aircraft and missiles, automatic pilot development, flight-test instrumentation and servomechanisms. Presently employed, but intends to leave the East and desires new connections, preferably in Southern California.

790. Aeronautical Engineer—B.S. in Aeronautical Engineering; age 29. Four years' experience as Army Air Force Maintenance and Supply Officer, B-26, B-24, and B-29. Desires position as maintenance supervisor for foreign or domestic air line. Also interested in position as sales and service representative for an export organization of aircraft, engines, and aircraft component parts. Details and references upon request.

788. Test Engineer—M.E. graduate of Lowell Institute, M.I.T. One and one-half years as structural test engineer on military aircraft and helicopters; 1½ years in charge of structural research tests and C.A.A. static tests for four-place personal plane, which included setting up a test laboratory to carry out the program. Desires to obtain similar position on the East Coast.

787. Engineering Test Pilot—Age 29, married. Continuously employed during the past 6 years by four major aircraft manufacturers as experimental or engineering test pilot; jet and reciprocal powered fighters, dive bombers, seaplanes, and helicopters. Actual stability, preliminary and final demonstration experience on Army, Navy and C.A.A. programs. Available within 30 days.

786. Aeronautical Engineer—B. of A.E. and A.E. degrees. Age 25, married. Experience: design and development of aeronautical and mechanical components; stress analyst; liaison engineer; processing. Desires position in above or related fields.

783. Engineer—Age 32, B.M.E., M. Aero. E., with 7 years' varied experience in analysis and research on commercial and military aircraft structures, guided missiles and power plants, including gas turbines; emphasis on stress analysis, thermodynamics, and fluid flow.

782. Power-Plant Engineer—Eight years' experience in gas-turbine power plants for aircraft and industrial applications. In charge of installation, service, and sales departments. Well versed in the organization and administration of sales and service sections. Has overseas experience in the service and sales field, plus technical advisory experience to foreign manufacturers. Desires administrative position with progressive aircraft firm, air line, or cargo company or in an engine manufacturer's sales organization.

781. Power-Plant Development Engineer—Age 31; married; B.S. in Aeronautical Engi-

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779. Aeronautical Engineer—B.Ae.S. degree, University of Minnesota, 1940. Age 31, married. Six years' experience with prominent aircraft propeller manufacturer involving drafting, weight control, aerodynamics, plus extensive experience in installation engineering pertaining to aircraft propellers. Held supervisory position in Installations Department at time of resignation to form own airport operations organization. Location open.

777. High School Aeronautics Teacher—Age 29, married. Author of three technical books on aviation education, aircraft operations, aviation course of instruction for high schools and colleges. Twelve years' practical experience in operational aviation, all phases. Seven years' aviation teaching experience. Teaching aeronautics in a Southern high school at present. Would like better position teaching basic or primary aerodynamics and/or structures in a college offering aeronautical engineering or aeronautical courses.

776. Sales Engineer—B. in A.E., Rensselaer Polytechnic Institute; age 26, married. Four and one-half years' research experience plus 20 months spare-time study (International Correspondence Schools) of corporate organization and finance, business law, accounting, and marketing. Private pilot. Desires sales engineering connection in industry where the combination of sales ability with a sound engineering background will be valuable. Location open. Salary incidental to advancement opportunities.

775. Aeronautical Engineer—B.S. in Aeronautical Engineering. Age 28, single. Thirty-two months' experience, 17 months in design layout, 15 months in flight testing. Desires position in Eastern United States in flight testing or research. Will consider design layout.

774. Engineer—Age 26, married. B.Ae.E., N.Y.U., 1944. One year of graduate work at N.Y.U. including courses in compressible flow, gas turbines, structural analysis, and advanced mathematics. Expects M.Ae.E. in October upon completion of thesis. Two years' experience in maintenance and inspection of A.A.F. transport aircraft as engineering officer both in U.S. and Pacific Theater. Location open.

773. Pilot—Engineer—B.S.Ae.E. from Purdue University. Age 25, single. Presently holds valid commercial pilot's license with single- and multi-engined, instrument, and instructor ratings. Acquired extensive experience as B-29 flight engineer during war. Leaving present position as flight supervisor at large Midwestern university airport. Interested in sales engineering, pilot for private concern, or flight-test work. Will locate anywhere but prefers East Coast.

772. Aeronautical Engineer—Aerodynamicist; B. Aero. E., N.Y.U., 1943. Age 24, married. Four and one-half years' experience in all phases of aerodynamics (propeller and jet aircraft), with emphasis on flight test and performance analysis; experience in supersonic aerodynamics pertaining to guided missile development. Will consider college teaching. Metropolitan New York, Northern New Jersey, and Long Island areas preferred. Details and references upon request.

771. Mathematician — Engineer — Age 33; B.S., M.A., 60 graduate credits in mathematics; 4 years' evening mechanical engineering course. Six years' experience teaching mathematics; 2 years' experience in aerodynamics, including

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transonic and supersonic aircraft and missiles; 1 year as research engineer on auto pilot and hydraulic shock absorbers; 2 years' administrative experience as manager of service department with manufacturer of aircraft hydraulic pumps and landing gears. New York, New Jersey, or Long Island area preferred.

770. Aeronautical Engineer—B.Ae.E., 1942. Age 25, married. Two years' experience in design evaluation of regular and experimental aircraft. Two years' experience in aircraft flight testing and aircraft maintenance. One year's experience in supersonic research leading to the design of guided missiles. At present engaged as a research technician in supersonics. Desires position as an administrative or project engineer. Familiar with Government contracts and procedures.

769. Aeronautical Engineer—B.S. in M.E. (Aero.), 1942. Age 27, married. Five years' experience in layout and design on military and commercial aircraft. Some experience in wind-tunnel testing and aeronautical research. Desires permanent position with leading aircraft concern. Will locate anywhere in United States.

768. Production-Management Engineer—B.Ae.E., Rensselaer Polytechnic Institute, 1942. Five years' experience in engineering and management, including duties in liaison, salvage, design, and stress analysis. Three years' aircraft engineering officer in U.S. Marine Corps in complete charge of third echelon maintenance, repair, and overhaul, as well as command responsibilities. Desires responsible position requiring managerial capabilities in addition to engineering knowledge, such as production planning and control.

767. Aeronautical Engineer—Age 23, married. Four years' experience in air-transport field. Thoroughly familiar with aircraft structures and systems, weight and balance procedures, structural repairs, and servicing. Two years' experience in detail design and interior furnishing of large commercial aircraft including DC-3, DC-4, and L-49 aircraft. Desires position of responsibility in which engineering background will be of value. Available immediately.

766. Aeronautical and Mechanical Engineer—Age 25. B.S. in G.E. with A.E. Option from Georgia School of Technology. Considerable work toward M.S. completed. Three years' experience in the development of aircraft engines (conventional and jet) and propellers in the Engineering Division, Air Matériel Command, Wright Field, as an officer. One year's experience in theoretical analysis of power plants, rocket research and development, and aerodynamics for guided missiles. Considerable experience as a pilot. Interested in sales engineering. Will locate anywhere. No objection to traveling. Good references.

764. Engineer—Ph.D., Master's, and Bachelor's degrees; age 30. At present, Director of Aeromechanics Department for large corporation engaged in research, design, and development in supersonic and subsonic guided missile programs. Formerly, Associate Professor of Aeronautical Engineering at midwestern university, teaching theoretical aerodynamics, supersonic and compressible subsonic flow, dynamic stability, and wind-tunnel courses. Desires professorship or associate professorship at recognized university with the possibility of some research or consulting or a responsible position in industry with good future prospects.

759. Powerplant and Engine Accessory Designer—Graduate M.E., German university. Extensive design and testing experience. Fully conversant with engine layout and all phases of development. Considerable design and research background on fuel injection systems.

757. Flight Test or Research Engineer—Aeronautical Engineering graduate with 5 years' experience in flight testing, flight research, and wind-tunnel testing. Has done military and C.A.A. acceptance flight tests. Special experience with large aircraft test organization. Intends to leave West Coast. Desires equivalent position in the East; New York or New England Coast preferred.

755. Mechanical Engineer—B.S. in Mechanical Engineering, age 28. Three years of performance estimation of gas turbines and thermodynamic analysis and design of gas turbine components. Three years of mechanical design of aircraft elements. Desires a responsible position with an active organization with plenty of work and an opportunity for advancement. Location unimportant.

754. Aeronautical Engineer—B.S. in Aeronautical Engineering, age 26. Forty months' experience in the Army Air Corps as an engineering officer in charge of maintenance and equipment development. Desires position in aerodynamic research but will also consider other positions. Sound theoretical background in stress analysis and aerodynamics as well as practical experience in heavy aircraft maintenance. Details and references upon request.

753. Engineer—B.M.E., 1943. Nine months' as assistant project engineer on automatic aircraft control. Two years as aerodynamics engineer on piloted and pilotless aircraft. For past 6 months in charge of projects to simulate in laboratory the behavior of guided missiles and their control equipment while in flight. Desires improved opportunities.

752. Engineer—Age 36, 3 years' college engineering; 2½ years as an engineer in the aircraft industry; specialist in weights and balance; holds valid A. & E. license; approximately 10 years all-round technician on all types of aircraft. Would like to represent aircraft manufacturer in the field.

751. Aeronautical Engineer—Seven years' air-line and manufacturing experience, mostly on heavy multiengined aircraft covering tool design, group leader equipment installation design, service and liaison engineering, flight testing, direction of preparation of flight and maintenance handbooks, and progressive maintenance systems for U.S. Navy and a major air line. Desires responsible position with air line or manufacturer, domestic or foreign. Excellent references furnished.

750. Aeronautical Engineer—B.Ae.E., age 24, single. Two years' experience in flight testing, primarily jet-propelled aircraft. Three and one-half years with A.A.F. as navigator, experimental engineering officer, and administrative officer. Seeks position in aeronautics, preferably development and/or liaison.

748. Aeronautical Engineer—Bachelor's and Master's degrees in Aeronautical Engineering. Presently holding responsible executive position with well-known helicopter manufacturer. Desires new connection either in industry or at recognized university. Broad general aircraft experience; author of several published papers on rotating wing aircraft and general design; well-known in industry and C.A.A. circles; teaching experience in field of structural design.

747. Helicopter Flight Test Engineer—Age 27, married. B.S.E. (Aero.), 1943. Familiar with C.A.A. flight test procedures and data reduction necessary for helicopter certifications. Four years' aviation experience includes flight-test instrumentation, conventional aircraft flight scheduling. Desires position in Midwest in related or nonrelated field where background would be of some benefit.

746. Aerodynamicist—Age 28; B.S. and M.S. degrees in Ae.E. Five years' experience in aerodynamic design of commercial and military aircraft. Considerable experience with static and dynamic stability analyses of aircraft. Desires responsible position either with aeronautical college or with aircraft industry.

745. Aeronautical Engineer-Teacher—Presently employed design engineer would prefer a change to teaching position. Work in aircraft industry or in aero-insurance field also desirable. Scholastic record includes B.S. degree in Mechanical Engineering and graduate study in applied mechanics, plus M.S. degree from Harvard Graduate School of Engineering. Over 6 years' industrial experience on gliders, large (four-engined), and small aircraft, amphibians and jets. Has been chief of structures and aerodynamics on light aircraft; handled approval of important aircraft designs while working for C.A.A.; has also handled safety and accident analysis, and C.A.A. design and liaison work for large aircraft manufacturer. Teaching experience includes graduate assistantship at leading university and appointment as Instructor in Aeronautical Engineering on part-time basis.

744. Project Engineer—Age 29; M.Ae.E. Nine years' experience in design and development of aeronautical and mechanical components. Recent experience in guided missiles and in direction of groups engaged in aeronautical development work. Especially interested in coordination of new development work.

Books

(*Continued from page 58*)

WORLD WAR II

Atom Bomb and Mass Destruction. Raffaele Giacomelli. Rome, Editoriale Aeronautico, 1947. 51 pp. L. 100. (In English.) With the appearance of the airplane in World War I, the idea arose among the nations of the world that not only had warfare itself been revolutionized but also the rules that had governed it. Wars were no longer fought by armies but by nations in their entirety. The author traces the origin of this idea and its development as a philosophy of warfare. He shows that the effectiveness of terrorizing entire populations and paralyzing the industrial capacity of an opponent did not, in practice, come about as predicted by this theory until the atomic bomb was used. This weapon, he claims, is the logical and ultimate development of air warfare and gives validity to the new theories of war. It is made evident that for the self-preservation of mankind some rules must be adopted by belligerents to control the disastrous effects of this weapon if the self-annihilation of mankind is to be avoided.

Devilbirds; The Story of United States Marine Corps Aviation in World War II. John A. De Chant. New York, Harper & Brothers, 1947. 265 pp., illus. $4.00. This is a well-documented account of the outstanding accomplishments of the Marine Corps Aviation in World War II. The book is the result of the author's close study and intimate association with the members and campaigns of Marine aviation over a period of nearly 4 years. It provides a graphic picture of what the air arm of the Marine Corps did in supporting 55 amphibious landings, shooting down 2,400 Japanese planes, and sinking some 900 enemy ships. The author has made every effort to present an account both accurate and fair but points out that some of the facts of the campaigns will never be known. A prologue chapter is included to record the activities of the Marine airmen in nearly 30 years of action prior to the recent war and to show the continuity of personnel and action which made possible the present story.

Admiral Halsey's Story. William F. Halsey and J. Bryan, III. New York, Whittlesey House, McGraw-Hill Book Co., Inc., 1947. 310 pp., illus., maps. $4.00. An authoritative account of the Naval war in the Pacific with details about the attack on Pearl Harbor, the launching of Lt. Col. James H. Doolittle's planes for their raid on Tokyo, the Battle of Leyte Gulf, and many other activities and achievements of the Navy's Pacific Fleet during World War II.

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★ *Specifications and further information on the aircraft products of these companies will be found in the*

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